NJ TRANSIT
The Way To Go.

Christine Todd Whitman
Governor

James Weinstein
Board Chairman

61936

July 13, 1999

FRA-1999-6137-1

Mr. Donald M. Itzkoff
Deputy Administrator
Federal Railroad Administration
1120 Vermont Avenue, N. W.
Mail Stop #5
Washington, DC 20590

Dear Mr. Itzkoff:

Enclosed is the Petition of New Jersey Transit Corporation for Approval of Shared Use and Waiver of Certain Federal Railroad Administration Regulations pursuant to 49 C.F.R. § 211.7. New Jersey Transit is seeking this approval and waiver in order to operate light rail service utilizing the temporally separated operation described in the Petition.

We believe that the Petition is consistent with the FRA/FTA Proposed Joint Policy Statement on shared use of the general railroad system since it ensures safety through complete temporal separation and oversight of the light rail service through the FTA approved State Safety Oversight Program which is administered by the New Jersey of Transportation.

We look forward to working with you. Please contact me if you have any questions or require additional information in order to evaluate the Petition.

Sincerely,

Dan Censullo
Senior Director, New Rail Construction

cc: George Gravalla
Ed English
Grady Cothen
Kevin Sheys, Esq.
Don Nelson - Conrail

NJT Petition for Approval of Shared Use and Waiver of FRA Regulations

Verification of Daniel Censullo

VERIFICATION

I, Daniel Censullo, hereby certify that the information and representations made herein are true and accurate to the best of my knowledge, information and belief.

Daniel Censullo
Senior Director, New Rail Construction
New Jersey Transit Corporation

Date: July 13, 1999

NJT Petition for Approval of Shared Use and Waiver of FM Regulations

Petition

BEFORE THE
FEDERAL RAILROAD ADMINISTRATION

Docket No. _____

PETITION OF NEW JERSEY TRANSIT CORPORATION
FOR APPROVAL OF SHARED USE AN-D
WAIVER OF CERTAIN FEDERAL RAILROAD ADMINISTRATION
REGULATIONS PURSUANT TO 49 C.F.R. $211.7

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ATTORNEYS FOR NEW JERSEY TRANSIT CORPORATION

Dated: July 13, 1999

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BEFORE THE
FEDERAL RAILROAD ADMINISTRATION

Docket No. ______

PETITION OF NEW JERSEY TRANSIT CORPORATION
FOR APPROVAL OF SHARED USE AND
WAIVER OF CERTAIN FEDERAL RAILROAD ADMINISTRATION
REGULATIONS PURSUANT TO 49 C.F.R. $211.7

I. INTRODUCTION

New Jersey Transit Corporation ("NJ Transit") hereby seeks approval of shared use and waiver of regulations from the Federal Railroad Administration ("FRA") for the light rail passenger operations described in this Petition and its Exhibits.

FRA may grant a waiver from its regulations "if the waiver is in the public interest and consistent with railroad safety." 49 U.S.C. § 20103(d). The FRA/FTA Proposed Policy Statement on shared use of the general railroad system, infra, says that, "FRA anticipates granting appropriate waivers of its rules to permit shared use of general system lines by light rail and conventional equipment where the applicant transit systems and railroads commit to alternative measures and FRA finds those measures will ensure safety. . . . Where complete temporal separation between light rail and conventional operations is achieved, the risk of collision between the two types of equipment can be minimized or eliminated." Policy Statement at 28239. NJ Transit respectfully submits that the waivers sought herein are in the public interest and consistent with railroad safety, because NJ Transit and the Consolidated Rail

Corporation ("Conrail") will establish complete temporal separation and NJ Transit will submit to safety regulation through state safety oversight.

NJ Transit is an instrumentality of the State of New Jersey, created to provide safe, reliable, convenient and cost-effective public transportation service throughout New Jersey. Covering a service area of 5,325 square miles, NJ Transit is the nation's third largest provider of bus, commuter rail and light rail transit, linking major points in New Jersey, New York City and Philadelphia. On 12 rail lines statewide, covering 542 miles of track, NJ Transit's fleet of 591 trains provides rail service to 15 counties, making 47 million passenger trips and traveling 1.1 billion passenger miles annually. NJ Transit operates a fleet of 1900 buses making over 141 million passenger trips per year. In addition, NJ Transit administers several publicly-funded programs for persons with disabilities, senior citizens, people living in the state's rural areas and disadvantaged transportation patrons. As the entity that connects New Jersey residents with employment, education, health care, and recreational opportunities around the state, NJ Transit is vital to the state's economic well being and to the quality of life of its citizens.

The newest component of the NJ Transit transportation system is the planned Southern New Jersey Light Rail Transit ("SNJLRT") system. SNJLRT is a regional light rail transit system that will link the cities of Camden and Trenton and provide local service and bus, transit and intra- and intercity rail transfer connections to an area previously without light rail service. The SNJLRT system will be a "rail fixed guideway system" as defined in the Federal Transit Administration's State Safety Oversight regulations, 49 C.F.R. § 659.5. The SNJLRT project will cover 34 miles using a combination of street running alignment and existing railroad right-of-way to assist in meeting Southern New Jersey's mobility and congestion needs. See Exhibit A.

A portion of the SNJLRT system will run over the existing Bordentown Secondary railroad right-of-way, between MP 1.07 (Camden) and MP 33.1 (Trenton). See SNJLRT Track Chart, Exhibit B. A street running segment of the SNJLRT system will be connected to the aforementioned section of track at Camden. The purpose of this submission is to secure waiver of certain regulations from the Federal Railroad Administration ("FRA") for SNJLRT operations over the portion of the system located in the existing railroad right-of-way. FRA has jurisdiction over this portion of the SNJLRT system because of its connection with the general railroad system of transportation.'

Section II outlines the facts relevant to FRA consideration of this petition. Section III contains the specific request for waivers and contains detailed information on the equivalent safety features of the SNJLRT equipment and operations that form the basis of the safety justification for the waivers requested. The Exhibits to this Petition, listed after the Table of Contents, provide substantive support for the requested relief, and are hereby incorporated by reference. The Petition contains a detailed description of both the SNJLRT and Conrail railroad operations on the Shared Trackage. The Petition contains a detailed description of the plan for separation of the SNJLRT operations from Conrail operations, including a description of protective systems that will be deployed to ensure that the simultaneous operation of SNJLRT

[1] The FRA has jurisdiction to regulate safety with respect to all railroads. Under the Federal Railroad Safety Act, as amended ("FRSA"), the only exception to FRA's jurisdiction *is* "rapid transit operations in an urban area that are not connected to the general railroad system of transportation." 49 USC $20102(l)(B). Although the SNJLRT system is a rapid transit operation in an urban area, it will connect to the general railroad system of transportation. Hence, FRA has the statutory authority to exercise jurisdiction over the SNJLRT system.

and Conrail will not occur. With respect to each of the rules for which a waiver is sought, the Petition describes alternative safety measures to be employed, including those required by FTA's State Safety Oversight Program. See Proposed Joint Statement of Agency Policy Concerning Shared Use of General Railroad System by Conventional Railroads and Light Rail Transit Systems, 64 Fed. Reg. 28238 (May 25, 1999) (the "Policy Statement") at 28240.

II. STATEMENT OF FACTS

As noted above, the SNJLRT system is a regional light rail transit system planned under the auspices of the NJ Transit that will link the cities of Camden and Trenton and provide local light rail service and bus, transit and intra- and intercity rail transfer connections to an area currently without light rail passenger service. The service will operate over (in part) a Conrail known as the Bordentown Secondary (hereinafter also referred to as the "Shared Trackage")*. Currently, the Bordentown Secondary is used to provide freight service to on-line customers and customers located on contiguous branch lines. NJ Transit will purchase the Bordentown Secondary and Conrail will retain the rights to use the line in pursuit of its common carrier rights and obligations. NJ Transit and Conrail have signed a letter of intent setting forth the basic terms of the sale and addressing operating terms and conditions between the parties (the "Letter of Intent"). See Exhibit C. NJ Transit and Conrail will incorporate the terms of the Letter of Intent into a new Operating Agreement.[3] This section sets forth pertinent information about the

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[2] The Bordentown Secondary is part of the "North Jersey Shared Assets Area," operated by Conrail for the benefit of Norfolk Southern Corporation and CSX Transportation, Inc.

[3] NJ Transit will provide a copy of the signed Operating Agreement to FRA after it is finalized.

physical characteristics of the SNJLRT system and operating characteristics of the SNJLRT system and Conrail's freight service.

A. Development of the SNJLRT System and the DBOM Process

NJ Transit is developing the SNJLRT system through a "Design, Build, Operate and Maintain" ("DBOM") process, by which a single Contractor team (the "SNJLRT Contractor") is selected to bring the project to fruition. Under the DBOM process, major system parameters, including track configuration and performance requirements for design, construction, operations and maintenance requirements are established by the transit agency and included in the bid documents. Then, in a competitive procurement, a DBOM contractor is selected who will prepare the final design requirements and be responsible for the construction, operation and maintenance of the system, under the supervision of the transit agency.

The DBOM process is increasingly prevalent for public transportation projects throughout the country because it enables the transit agency to obtain high quality products and services in a timely and cost-efficient manner. By integrating the design, construction and operation stages of the project, the transit agency is able to enjoy the cost savings from conducting one procurement (instead of several) and the relative economies of scale derived from the DBOM contractor's ability to work on an integrated basis. The contractual relationship between the DBOM contractor and the transit agency creates a partnership in which the transit agency has significant control and cversight of the project, while the DBOM contractor assumes significant shared responsibility for the success of the project, including accountability to the transit agency for safety matters.

In this case, NJ Transit's DBOM contractor selection process was conducted in two stages. Bidders were invited to submit initial technical proposals in April 1998. Five proposals were received and reviewed by NJ Transit for compliance with the bid documents. Feedback on deficiencies was provided to the bidding teams. The bidders were then invited to submit final technical proposals and price proposals in August 1998. The final technical proposals were evaluated by NJ Transit and technical scores awarded to each acceptable proposal. The price proposals were then opened in public in November 1998 and scores were awarded to each bid in accordance with the formula contained in the bid documents. The Southern New Jersey Rail Group, a team effort of Bechtel Civil Company and ABB Daimler-Benz Transportation (North America) Inc. ("Adtranz"), was selected as the DBOM contractor and the contract was executed on June 30, 1999. NJ Transit anticipates issuing a notice to proceed with final design and construction to the DBOM contractor by the end of September 1999. Under the terms of the bid documents, the selected SNJLRT Contractor will operate the service for ten years.[4] After the initial ten-year period, NJ Transit may assume the operations and maintenance responsibilities for the system or may continue to contract out for operations and maintenance.

System safety design criteria were an integral part of the SNJLRT project DBOM bid documents. NJ Transit designated safety design criteria of various elements of the SNJLRT system (vehicles, equipment, facilities) and requirements specific to job safety during construction and operation in the bid documents to be addressed by bidders. In addition, the bid documents identified mandatory safety and security requirements to be met during the design,

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4 If at any time during the initial 10 year operating period the SNJLRT contractor should be found to be operating the SNJLRT system in an unsatisfactory manner, NJ Transit has the ability to assume responsibility for operation of the system.

construction and operating and maintenance phases of the project. Specifically, the bid documents require the SNJLRT Contractor to develop: (1) a comprehensive System Safety Program Plan for the operation and maintenance of the system; (2) a System Certification Plan for verifying that all of the SNJLRT elements are satisfactorily completed and result in a safe transit system; (3) a Safety Certification Verification Report describing the process, responsibilities, documentation and procedures used for safety certification; and (4) a System Security Plan to deal with security threats and vulnerability management of the SNJLRT system. See Exhibit D. These plans will be implemented and administered in accordance with State and Federal rail safety oversight requirements.[5]

One of the major safety-related responsibilities of the SNJLRT Contractor will be to organize a Safety Committee which will include representatives from NJ Transit and Conrail management, local police departments, emergency response agencies, and SNJLRT operations and safety managers. The purpose of the Safety Committee, which will meet monthly, will be to coordinate all of the safety-related activities of all project participants and disseminate safety information both internally and externally. The Committee's responsibilities will also include the review and approval of operating procedures and the development of reporting requirements as they pertain to accidents, injuries and unsafe conditions.

The Southern New Jersey Rail Group's proposal satisfactorily addressed all of the safety issues in the bid documents. Once the Southern New Jersey Rail Group receives the Notice to Proceed, it will work with NJ Transit to develop final safety specifications and procedures as required.

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5 See the discussion of State Oversight of the SNJLRT system at Section II.G., below.

B. Physical Characteristics of the SNJLRT System

The SNJLRT system will be constructed and operated from Camden, northeast along the Delaware River through the riverfront communities, under Interstate-295, through Bordentown and north into downtown Trenton, terminating at the Trenton Northeast Corridor station. The system will have 20 station stops, providing access to such major activity centers as the Waterfront Entertainment Center, the State Aquarium in Camden, Walter Rand Transportation Center, the Delaware River riverfront towns, Trenton's baseball park, the new ice hockey and basketball arena and the Trenton Northeast Corridor station.

The station stops will all be at-grade and will have platforms approximately 22 inches high and 200 feet long fitted with shelters, seats and lights. Station stops will be designed and constructed in accordance with the New Jersey Uniform Construction Code, the Illuminating Engineering Society Handbook, the National Electric Safety Code and National Fire Protection Association standards as applicable.

Of the 34 miles of the SNJLRT system, there are two miles of street-running track in the City of Camden, approximately three miles of new track within the existing right-of-way between MP 1.07 and Ml? 4.3, and a short section of track from MP 33.1 to the terminal opposite Trenton Northeast Corridor station which is outside the existing right-of-way.[6] The remainder of the SNJLRT system is the Shared Trackage. See SNJLRT System Map, Exhibit A and the SNJLRT Track Chart, Exhibit B.

Most of the Shared Trackage is constructed to provide double track. Wherever possible, 17-foot track centers are being provided in accordance with Conrail's standards on double track

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6 There will be no freight service along any of these segments of track.

sections. There are, however, areas where less than 17-foot centers currently exist and, due to physical constraints such as historic structures, an increase in track centers is not possible. In addition, there are two segments of single track located between MP 17.6 and MP 18.5; and MP 26.9 and MP 27.4.

All SNJLRT vehicle movements will be controlled and monitored by the SNJLRT Central Traffic Control Center. Along the Bordentown Secondary portion of the route, an FRA compliant signaling system will inform SNJLRT and freight tram operators of train movements. The installation of this FRA compliant signaling system represents a significant improvement to the right-of-way, which heretofore has had signalization limited to locations at CP Hatcha (MP 4.3) and Rancocas Bridge (MP 12.3).

There are forty-nine (49) at-grade crossings on the Shared Trackage. Each of these will be protected in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) to a design approved by the New Jersey Department of Transportation, after a public review process involving local emergency services, municipalities and transportation planners. The crossings will be operated and maintained in accordance with FRA regulations.

C. **The SNJLRT Equipment**

SNJLRT service will be provided on modified Adtranz GTW 2/6 partial low floor articulated vehicles. The characteristics of the SNJLRT vehicles are summarized in Table II- 1. See Exhibit E for additional information.

TABLE II-1
Vehicle length: 102.5 feet
Vehicle weight: 52 tons (114,600 pounds)
Vehicle capacity (maximum): 100 seats, plus 100 standees
Maximum speed: 60 mph
Emergency braking rate: 4.5 mph/sec
Safety design requirements (highlights): • System collision avoidance through the use of a combination of vital systems and operating procedures, including Train Control technology incorporated in the signal system (with trip-stop capability), and emergency braking activated by at least two independent fail-safe methods. • Enhanced vehicle crashworthiness through an energy management approach used as the basis of car structural design, combined with design elements to minimize deceleration of passengers in the event of a collision. • Additional vehicle safety features such as positive train separation and automatic train stop; door circuitry and sensitive door edges to stop the tram should an unauthorized door opening occur; manual door release controls; handholds and stanchions; safety glazing; normal and emergency interior and exterior lighting; train radio, passenger intercoms and silent alarms; interior materials selected for flame and smoke retardant properties.

D. SNJLRT and Conrail Operations over the Shared Trackage

Once operational, the SNJLRT system expects to make 9,300 transit trips per day in its first year of operation, increasing to over 16,300 per day in the year 2020. The SNJLRT system will run from 6:00 a.m. to 10:00 p.m., daily, serving 20 stations in 15 minute headways during peak hours and 30 minute headways during off-peak hours. At the outset the SNJLRT system will operate diesel light rail vehicles capable of accommodating 200 passengers each (100 seated). SNJLRT vehicles will be operated by one-person crews and operations on the Shared

Trackage will be conducted in accordance with the Northeast Operating Rules Advisory Committee ("NORAC") operating rules.[7]

As noted above, Conrail will retain the right to use the Bordentown Secondary for its freight operations. Freight service currently is provided by three freight crews on most days. Current freight traffic involves movement of approximately 5,800 carloads (11,600 car movements) a year. Conrail's freight service will be conducted during the hours of 10:01 p.m. to 5:59 a.m., daily.

A SNJLRT yard and maintenance facility will be located in Camden. The facility will accommodate equipment for maintenance and repair of the SNJLRT vehicles, signaling equipment, and track. The operations and management offices as well as the Central Traffic Control Center will be located at the yard and maintenance facility site. In addition to the Camden storage site, storage tracks will be provided in the vicinity of Trenton to permit overnight storage of up to eight vehicles.

E. Temporal Separation of Operations and Control of the Shared Trackage

The SNJLRT system will be physically separated from freight operations along its section of street-running track and time separated from freight operations on the Shared Trackage. The SNJLRT vehicles wili not use freight-only sidings connected to the Shared Trackage and will be prevented from entering those sidings by automatic train-stop devices. Specifically, Conrail and NJ Transit have agreed that transit operations will have exclusive use of the Shared Trackage during a "Passenger Period" and that freight operations will have exclusive use of the Shared Trackage during a "Freight Period." The Passenger Period runs between the

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[7] Conrail operations are also governed by NORAC rules.

hours of 6:00 a.m. until 10:00 p.m., daily, and the Freight Period runs between the hours of 10:01 p.m. and 5:59 a.m., daily. This temporal separation will minimize or eliminate the risk of a freight train/SNJLRT vehicle collision within the Shared Trackage area.

NJ Transit and Conrail intend to strictly observe and enforce the provisions within the Letter of Intent relating to the Freight and Passenger Periods. The periods will be completely distinct and NJ Transit and Conrail have developed procedures and will apply particular technologies to ensure strict observation of the respective Periods. See Policy Statement at 28239. NJ Transit and Conrail have also planned for the contingency of freight train or SNJLRT vehicle presence on the Shared Trackage outside of the applicable Period.

NJ Transit and Conrail have developed procedures to govern dispatching of passenger and freight trains and clear transition from passenger transit service to freight rail service. The SNJLRT Contractor, operating out of the Central Traffic Control Center, will have sole authority and responsibility for dispatching of passenger and freight trains on the Shared Trackage, 24 hours a day, seven days a week. Control Center personnel also will be responsible for implementing corrective actions to maintain service schedules and minimize adverse impacts from equipment failures and emergency situations.

Dispatchers will be able to monitor passenger and freight tram movements and set routes along the Shared Trackage from workstations having a visual display of the route which show the block occupation of all trains on the system. The workstations will be configured with password-protected, vital control software to allow the active setting of routes on the Shared Trackage from only one workstation at a time. Dispatchers at workstations who have not gained access to the active control feature may only monitor train occupation and movements. With this software, the dispatcher who has "keyed-in" is in control and has sole authority over the Shared Trackage and will "lock out" trains from the other operation from entering the Shared Trackage by setting derails and/or trip-stops.

As the end of the Passenger Period approaches, the dispatcher will route SNJLRT vehicles off of the Shared Trackage in accordance with the SNJLRT service schedule. The dispatcher will ascertain that all SNJLRT vehicles have left the Shared Trackage, as shown on the workstation monitor. Additionally, the dispatcher will be required to confirm by radio with the train operators that they are clear of the Shared Trackage. When the dispatcher is assured in this way that there are no SNJLRT vehicles on the Shared Trackage, he or she will enter a password to transfer active control through the workstation from SNJLRT to freight dispatching.[8] This action will automatically "lock out" SNJLRT vehicles from the Shared trackage using trip-stops. Following the transfer, the dispatcher can begin authorizing routes for Conrail train movements.

Similarly, at the end of the Freight Period, the dispatcher will monitor freight movements on the Shared Trackage to determine that all freight movements over the Shared Trackage are complete. The dispatcher will then confirm by radio the location of each freight train. With this redundant assurance that there are no freight trains on the Shared Trackage, the dispatcher will enter a password to transfer active control through the workstation from freight to SNJLRT operations. This action will automatically "lock out" Conrail trains from the Shared trackage

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8 If there is a change of dispatchers occurring at the same time as the switch over between the Passenger and Freight Periods there will be operating procedures requiring a formal transfer of control, including notification of section vacancy and relinquished control, and confirmation of maintenance activities occurring during the Freight Period.

using derails. Following the transfer, the dispatcher can begin authorizing routes for SNJLRT vehicle movements.

If either a SNJLRT vehicle or a Conrail train is late and occupies the Shared Trackage after expiration of the applicable Period, the dispatcher shall not complete the transfer of access to the Shared Trackage to the party that is supposed to have access to the Shared Trackage until the late service clears the Shared Trackage. For example, if Conrail has service delays due to a disabled train and is still on the Shared Trackage at 6:30 a.m. (30 minutes after the end of the Freight Period), the dispatcher will not transfer active control on the workstation allowing for SNJLRT access to the Shared Trackage until the freight train is known to have left the Shared Trackage in accordance with the procedures explained in detail above. In such a case, no SNJLRT service could begin on any part of the Shared Trackage until after the freight train is known to have left the Shared Trackage.

On rare occasions, the dispatcher may extend the Passenger Period by granting special permission to NJ Transit to enter or stay on the Shared Trackage during what otherwise would be the Freight Period or may extend the Freight Period by granting special permission to Conrail to enter or stay on the Shared Trackage during what otherwise would be the Passenger Period. Such special permission would be based on the cessation or postponement of the service that would normally be operating. For example, if NJ Transit arranges for special event SNJLRT service and that train will run on any part of the Shared Trackage after 10:00 p.m. on that day, there will be no Conrail trains permitted on the Shared Trackage until after the SNJLRT special service is completed in accordance with the same procedures explained in detail above.

F. Adjacent Operations

There are two sections of Conrail track immediately north of Pavonia Yard that run parallel to the Shared Trackage but are not part of it or connected to it. The first is a segment of the Pemberton Industrial Track from the diamond crossing at CP Hatch (MP 4.3), which rapidly rises and diverges from the Shared Trackage to connect with Conrail's Hatch Industrial Track (MP 4.6). The second is the track running from the Delair Bridge to Pavonia yard and runs adjacent to the Shared Trackage from MP 4.3 at CP Hatch to MP 3.13, which is the entrance to Pavonia Yard. A third section of Conrail track located south of Pavonia Yard, from MP 1.15 to MP 1.7, runs parallel to the Shared Trackage, but is not part of the Shared Trackage or connected to it. See Exhibit B.

There are three other parallel track segments/sidings where Conrail can move freight independently of SNJLRT operations on the Shared Trackage during the Passenger Period. As noted above, these tracks are exclusively for freight usage and protected from SNJLRT vehicle encroachment by trip-stops. They are the Pennsauken Industrial Track (MP 5.25 to MP 5.7); the Colorite Siding (MP 16.05 to MP 16.5) and the Burlington New Yard (MP 18.24 to MP 22.3). Track centers along each stretch of parallel track are a minimum of 17 feet.[9] See Exhibit B.

There are two diamond crossings on the route: one near River Road (MP 1.7) at the south end of Pavonia Yard, which only will be used during the Freight Period; one north of CP Hatch (MP 4.3), which may be used by Conrail during the Passenger Period. See Exhibit B.

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9 There are 18 additional sidings/industrial spurs connected to the Shared Trackage served by Conrail trains only during the Freight Period. These sidings/industrial spurs do not present any safety issues, because they will not be used by Conrail during the Passenger Period and they are interlocked with the signal system by electric locks.

Physical and operational barriers are in place to ensure the safety of SNJLRT and Conrail operations relative to these facilities are discussed below.

1. Parallel Track Segments

NJ Transit has taken steps to minimize the possibility of an encroachment risk during the Passenger Period on the Shared Trackage related to Conrail operations on the Pemberton Industrial Track, the track between the Delair Bridge and Pavonia Yard, and the parallel track segment south of Pavonia Yard. Encroachments could arise from shifted loads on freight equipment”, or derailments due to suspension/mechanical defects on any rolling stock or track. With limited exceptions track centers along each stretch of parallel track are a minimum of 17 feet from the centerline of the parallel track. This distance between track centers minimizes the risk of fouling the Shared Trackage by load shifts or equipment mishaps on adjacent tracks.

The parallel segments where the centerline track distance is less than 17 feet are: (1) between MP 1.2 and MP 1.4 (approximately 1200 feet); and (2) between MP 3.4 and MP 3.7 (approximately 1600 feet). In the first segment the tracks converge to a minimum of approximately 13 feet between track centers where the tracks cross over two short bridges (at MP 1.3, Federal Street, and MP 1.4, Route 30). On the bridges, through girders located between the tracks provide a physical barrier to encroachments. On the second segment, the tracks converge to a minimum distance of approximately 13.25 feet between track centers where the tracks pass under a roadway bridge (at MP 3.5, River Road Bridge). In this section concrete bridge abutments provide a physical barrier between the tracks. Conrail operations along each segment will proceed at a maximum speed of 25 MPH. The low speed operation on these parallel tracks

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10 Passenger vehicles do not experience shifted loads.

further reduces the likelihood that a derailed Conrail train or shifted load would foul the Shared Trackage.

In the Policy Statement, FRA and FTA state their intention to "coordinate with rapid transit agencies and railroads wherever there are concerns about sufficient intrusion protection and related safety measures designed to avoid a collision between rapid transit trains and conventional equipment." Policy Statement at 28240. NJT will coordinate with FTA and FRA to consider the need for other means of intrusion detection linked to the signal system for parallel track segments not protected by physical barriers.

On the three adjacent sidings Conrail may use during the Passenger Period on the Shared Trackage, the 17 foot track centers minimize the risk of fouling the Shared Trackage. Furthermore the extremely low speed (typically 5 - 10 MPH) nature of Conrail operations on these sidings further reduces the likelihood of fouled Shared Trackage.

2. Sidings

As noted above, there are 18 sidings adjacent to the Shared Trackage. During the Passenger Period the Conrail dispatcher (responsible for movement of freight trains outside the Shared Trackage) will be authorized to permit freight trains on these sidings to move up to the signal protecting entry to the Shared Trackage. Absent precautions, siding-related collisions could result from equipment rolling out from the siding onto the Shared Trackage or from an unauthorized movement of a freight train from the siding to the Shared Trackage. Under normal conditions, the risk of such occurrences is low because Conrail operating procedures require cars which are set off to have the brakes applied and to be chocked and prohibit freight trains from entering the Shared Trackage during the Passenger Period. The risk can be further reduced, however, by the placement of fouling limit signs on the siding and installation of derails beyond the fouling limit to derail a "runaway" car or unauthorized train before it can foul the right-of-way. Conrail has agreed to install such signs and derails on each of the sidings adjacent to the Shared Trackage.

As described above, the dispatcher controls access to the Shared Trackage for all movement on and off sidings. All siding locations are protected by power switches or electric locks tied into the signal system. With assurance that the Shared Trackage is clear of all SNJLRT vehicles, the dispatcher will align the route and set the signals for the freight movement. This sequence will serve to prevent freight movements off of sidings onto the Shared Trackage while SNJLRT vehicles still occupy the track, thereby eliminating the risk of collisions between Conrail trains and SNJLRT vehicles during the transition from the Passenger Period to the Freight Period.

3. Operations Over the Diamond Crossing

As noted above, there is one diamond crossing at the north end of Pavonia Yard that is connected to the Shared Trackage and that will be used by both Conrail and NJ Transit during the Passenger Period. Freight tram and SNJLRT vehicle movements across the diamond during the Passenger Period will be managed under the coordination and direction of the dispatcher. The procedures and physical barriers described below will serve to minimize the risk of collisions at the diamond crossing.

SNJLRT vehicles will be routed across the diamond during the Passenger Period under the direction of the dispatcher in accordance with the SNJLRT service schedule. The progress of the SNJLRT vehicle across the diamond will be monitored by the dispatcher at the workstation monitor. In addition, the dispatcher will be required to confirm by radio the location and progress of SNJLRT vehicles with the train operators.

In circumstances in which a Conrail train needs to move across the diamond during the Passenger Period, the Conrail dispatcher can permit freight trains to move up to the signal protecting entry to the diamond crossing, but must request permission from the Shared Trackage (SNJLRT) dispatcher to enter the crossing. Once the Shared Trackage dispatcher is assured that the diamond crossing is clear of all SNJLRT vehicles (by the signal system and by radio), the dispatcher will confirm by radio the location of the freight train, align the route, set the signals and will communicate movement authority to the Conrail dispatcher and locomotive engineer." The Shared Trackage dispatcher will then authorize the freight movement across the diamond.[12] Wayside signals will indicate to the freight train operator that the train has permission to move across the diamond. Once the freight train is clear of the diamond and the Shared Trackage dispatcher has confirmed its location by radio, the freight route will again be "blocked," thus preventing any additional freight train movements across the diamond without permission and clearance in the manner described. The Shared Trackage dispatcher will then resume the process of setting routes for SNJLRT vehicles movements.

While freight trains are moving across the diamond, SNJLRT vehicles will be prevented from entering the diamond.[13] In addition to the instructions from the dispatcher prohibiting such

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[11] Simultaneously the control logic will lock out the signals and route associated with SNJLRT traffic. Automatic trip-stop will prevent unauthorized intrusions by SNJLRT vehicles into the diamond.

[12] The Conrail dispatcher will be able to monitor this movement, but will not gain authority over the tracks.

[13] If the route is set for freight traffic SNJLRT vehicles will be held at the nearby stations at 36th Street (northbound direction) and Route 73 (southbound direction).

entry, derails will be installed to prevent unauthorized intrusion onto the diamond. Track circuits will also detect intrusion resulting in the SNJLRT signals turning to “Stop.” These stop signals are enforced by trip-stops.

G. **New Jersey State Safety Oversight of the SNJLRT System**

As noted above, the SNJLRT System Safety Program Plan and System Security Plan (collectively the "SSPP")will be implemented and administered in accordance with the FTA Fixed Guideway State Safety Oversight rules at 49 CFR Part 659 and the New Jersey State Safety Oversight Program. The State Oversight Program, conducted under the auspices of the New Jersey Department of Transportation (“NJDOT”‘), is currently providing safety regulation of the Newark City Subway and oversight in developing the safety program for the Hudson-Bergen Light Rail Transit System. NJDOT’s State Oversight Program has been found to be in compliance with FTA requirements under 49 CFR Part 659. See Exhibit F.

As part of the State Oversight Program, NJDOT has issued a System Safety Program Standard (“SSPS”) that establishes the relationship between NJDOT and NJ Transit fixed guideway rail systems not regulated by FRA and specifies the elements that must be addressed in the SSPP. Under the SSPS, the SSPP must set forth a policy embracing system safety and security and articulate long term, qualitative and realizable goals for system safety and security. The Plan must provide for:

- operating rules/procedures and training and certification requirements for Operations and Maintenance personnel;
- equipment operation, inspection, maintenance and testing standards;
- hazard identification, categorization and resolution;

- emergency and contingency planning;
- security and threat assessment, training, planning and procedures; and
- accident and incident reporting.

The initial SSPP and subsequent amendments must be submitted to NJDOT for approval. See Exhibit G.

The SSPS also requires that the transit agency conduct annual internal audits to evaluate compliance with the SSPP and measure its effectiveness. A yearly audit report must be submitted to NJDOT and actions must be taken, as appropriate, to remedy and deficiencies demonstrated by the audit. In addition, NJDOT will conduct a safety review once every three years to evaluate the effectiveness of the agency's implementation of its SSPP and actions must be taken, as appropriate, to remedy and deficiencies demonstrated by the review. See Exhibit G.

NJDOT also has responsibility under the State Oversight Program for accident investigation. The SSPS establishes the requirements for NJDOT investigation of accidents, incidents and unacceptable hazardous conditions. It sets forth the circumstances in which the National Transportation Safety Board will investigate, when the transit agency may conduct the investigation and when NJDOT will investigate directly. NJDOT will retain responsibility for confirming investigation reports and oversight activities to ensure that corrective action plans are implemented by the transit agency. See Exhibit G.

III. REQUESTS FOR WAIVERS OF SPECIFIC FRA REGULATIONS

On May 25, 1999, FRA and the FTA issued a proposed Joint Policy Statement on the safety regulation of freight and passenger rail operations on shared track. Under the proposed Policy Statement, FRA will assert jurisdiction over all operations on track that is part of the general railroad system of transportation (excluding street-running track connected to such general railroad system track), but will entertain waivers from many of its regulations for passenger rail transit operations which will be temporally separated from freight operations on the shared general system track. The passenger rail operations not regulated by FRA will be subject to state safety oversight pursuant to the FTA State Safety Oversight regulations. See Policy Statement at 28240.

NJ Transit seeks waiver of the FRA regulations identified and discussed in this Section III. NJ Transit intends to conduct SNJLRT operations over the Shared Trackage in accordance with all other applicable FRA regulations and in accord with the interim bridge safety guidelines issued on April 27, 1995. This waiver request does not cover operations over the street-running portions of the SNJLRT system. See Policy Statement at 28239-40.

A. List of Regulations From Which Waiver Is Sought

NJ Transit seeks a waiver of the FRA regulations as identified and discussed in this Section. Table III-l lists the parts of49 C.F.R. for which NJ Transit seeks waiver of compliance, in whole or in part:

TABLE III-1

221	Rear end marking device - passenger, commuter and freight trains
223	Safety glazing standards
229	Railroad locomotive safety standards
231	Railroad safety appliance standards
238	Passenger equipment safety standards
239	Passenger train emergency preparedness

B. Need and Justification for Waivers - Generally

1. Need for Waivers - Generally

Most of the waivers NJ Transit is seeking in this Petition relate to the design and performance requirements of the SNJLRT vehicles. These waivers are necessary because the SNJLRT system will be not be utilizing conventional commuter rail equipment. Light rail transit operations are, by their very nature, significantly different in character from commuter rail operations and the design of SNJLRT vehicles reflects those differences.

The impetus for considering passenger rail service along the Shared Trackage was a 1996 act of the New Jersey legislature directing NJ Transit to "study the feasibility and cost of instituting rail passenger service from the City of Camden to the City of Trenton, making use of existing rail freight lines or rights-cf-way, with stops at intermediate points in the municipalities bordering, or adjacent to, the Delaware River." The Statement accompanying passage of the Act states that the "use of existing rail trackage or rights-of-way for instituting rail passenger service is of fundamental importance to the rational growth and development of the State of New Jersey" and specifically identifies the Bordentown Secondary line as providing an 'unparalleled opportunity" to institute passenger rail service. The Statement also states that "not using mass transit facilities could lead to excessive reliance upon the passenger automobile, with the attendant problems of congestion and pollution." L. 1996 C. 18.

Several physical considerations were critical to the selection of LRT service. Several miles of service in Camden will extend into downtown streets through the city. A possible future extension from the LRT Trenton Station to the New Jersey State House will be provided through street-running alignment in Trenton. In addition, the SNJLRT system is expected to provide service opportunities beyond those mentioned here. The Camden service will allow passengers to reach desirable employment, educational and recreational centers. In these areas, trains must be able to negotiate narrow streets and 90 degree turns with radii of 132 feet. In addition, gradients of six percent are required to get to the street-running portions of the route and LRT cars can negotiate this while conventional commuter trains cannot.

SNJLRT service has benefits over commuter rail service for the historic communities it serves through reduced visual intrusion. The SNJLRT vehicles are physically smaller and more aesthetic in design than commuter trains. The station stop platforms will be lower and shorter, creating less visual and physical obstruction and will be more in character with the historic nature of the communities being served by the system.

Residential communities are sensitive to excess noise and vibration, particularly early in the morning and late at night. SNJLRT vehicles will be quieter than commuter trains and will generate less vibration. SNJLRT vehicles will be fitted with modem low emission diesel engines and will result in an overall reduction of air pollution in the region.

SNJLRT vehicles are designed to have low maintenance requirements and to be economical in the use of fuel. These features provide economic benefits over conventional commuter trains, making frequent service throughout the day less expensive.

2. Safety Justification for Waivers - Generally

In granting waivers for shared use, FTA and FRA have expressed an intention to "maintain the level of safety typical of conventional rail passenger operations while accommodating the character and needs of light rail transit operations." Policy Statement at 28240. As is more fully explained in the section below (and throughout this Petition) the

SNJLRT system will meet or exceed the level of safety typical of conventional rail passenger operations.

a. *Temporal Separation*

FTA and FRA recognize that "[w]here complete temporal separation between light rail and conventional operations is achieved, the risk of collision between the two types of equipment can be minimized or eliminated. Policy Statement at 28239. As noted above, SNJLRT operations will be conducted on a temporally-separated basis from Conrail's freight operations. Specifically, Conrail and NJ Transit have agreed that transit operations will have exclusive use of the Shared Trackage during the Passenger Period. This temporal separation will be enforced through strict observance of the dispatching and track control procedures described in Section II.E., above. In addition, the use of derails and trip-stops at access points to the Shared Trackage will serve as physical barriers to unauthorized entry onto the Shared Trackage. Thus, the risk of a freight train/SNJLRT vehicle collision within the Shared Trackage area will be minimized or eliminated.

b. *System Safety Within the Passenger Period*

When considering waiver requests related to shared use FRA has indicated that it will, with FTA's assistance, "make every effort in its waiver process to give due weight to elements of the operation's system safety plan that carry over into the shared use portion of the system". Policy Statement at 28240. As previously explained, the SNJLRT Contractor will develop: (1) a comprehensive System Safety Program Plan for the operation and maintenance of the system; (2) a System Certification Plan for verifying that all of the SNJLRT elements are satisfactorily completed and result in a safe transit system; (3) a Safety Certification Verification Report describing the process, responsibilities, documentation and procedures used for safety certification; and (4) a System Security Plan to deal with security threats and vulnerability management of the SNJLRT system. See Exhibit D. The SSPP will be implemented and administered in accordance with FTA and NJDOT regulations for rail safety oversight, which will provide a level of safety at least equivalent to that provided by the FRA regulations discussed herein. See the discussion at Section II.G., above. NJ Transit certifies that the subject matter of each of the waivers sought herein will be addressed in the SSPP and will be monitored by NJDOT.

(1) Collision Avoidance

As described in greater detail below, the risk of collisions, whether between freight trains and SNJLRT vehicles, between SNJLRT vehicles or between SNJLRT vehicles and other objects (both on the tracks and at grade crossings) on the SNJLRT system will be minimized to the fullest extent possible.

First and most importantly, through temporal separation of operations, SNJLRT vehicles and freight trains will remain separated from each other. Additionally, the signaling system and the operating procedures of both SNJLRT and Conrail will ensure that:

- Freight trains are restricted from access to the Shared Trackage during the Passenger Period by operating rules with such restricted access reinforced by the signal system and logic control features of the dispatching workstations.
- SNJLRT vehicles are restricted from access to the Shared Trackage during the Freight Period by operating rules with such restricted access reinforced by signal system and control logic devices.

- If SNJLRT vehicles occupy Shared Trackage beyond the designated Passenger Period for any reason, Conrail trains will not be permitted to enter any part of the Shared Trackage.
- If Conrail trains occupy the Shared Trackage beyond the designated Freight Period for any reason, SNJLRT vehicles will not be permitted to the enter any part of the Shared Trackage.

Given the significant responsibility that dispatchers will have concerning the safety of the SNJLRT system, proper training of the dispatchers is vital. The SNJLRT dispatchers will be trained in accordance with a training program to be developed by the DBOM Contractor with NJ Transit which will focus on achieving the safe operation of the system. The training program will be structured to ensure that each new employee receives a combination of classroom and on-the-job instruction, culminating in an examination and certification. The training program will include all functions for which the dispatchers will be responsible, including central dispatching duties, emergency response duties, the use of signal work stations, and radio and telephone based communications systems used in the central control center. The training program will also include refresher training and recertification procedures to ensure dispatchers remain current in their knowledge and skills. Additional training will be provided for supervisors of dispatchers.

In addition to the rules providing for control of movements by the SNJLRT dispatcher, the collision avoidance system is augmented by train control technology incorporated in the signal system and designed to physically prevent the occupation of a block of track by more than one train. As noted previously, at entrance points to the Shared Trackage switch point derails will be interlocked with the signal system and will remain in the derailing position until the signal is cleared for a movement onto or off of the Shared Trackage.

All signals capable of displaying a "stop" aspect will incorporate a trip-stop which prevents a SNJLRT vehicle from entering a block for which the route is not set or is improperly occupied by a freight train, by initiating a penalty brake application if the SNJLRT vehicle passes a "stop" signal aspect. Once tripped, the vehicle operator will be able to reset and proceed, but only after the SNJLRT vehicle has come to a complete stop and the operator has received permission from the dispatcher to resume travel.[14] Each application of the penalty brake will be recorded on the vehicle and the radio authorization will be recorded. These features minimize the risk of collision due to SNJLRT vehicles improperly occupying a segment of the Shared Trackage.

Operating rules applicable to both Conrail and SNJLRT will require each party to provide prompt notice by radio to the dispatcher of derailments and other incidents on any track. The dispatcher in control will be responsible for notifying the other party and controlling movements in the area of any derailment or incident.

NJ Transit will control the risk of collisions between two SNJLRT vehicles with a combination of operating rules and vehicle control technology. The NORAC operating rules and the final operating and dispatching procedures to be developed by the SNJLRT Contractor will control movements of passenger trains. At a minimum, SNJLRT vehicles will be required to obey speed limits and wayside "stop" signals. In addition, Control Center personnel will have automatically updated local block information and will provide train location information to

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[14] Each time the automatic trip-stop is activated a record of that activation will be made.

trains as necessary. These procedures are intended to ensure that trains do not approach each other closely enough to present a safety hazard.

The operating rules will be reinforced by the SNJLRT vehicle control technology. Specifically, all signals capable of displaying a "stop" aspect will incorporate a trip-stop which will initiate a penalty brake application if a SNJLRT vehicle passes a "stop" signal aspect. Once tripped, the vehicle operator will be able to reset and proceed, but only after the SNJLRT vehicle has come to a complete stop and the operator has received permission from the dispatcher to resume travel. Each application of the penalty brake will be recorded on the vehicle and the radio authorization will be recorded. This minimizes the risk of collision between SNJLRT vehicles due to one train fouling a conflicting route or improperly entering an occupied block.

The danger of encroachment collisions between SNJLRT vehicles on parallel track, between SNJLRT vehicles on the main track and freight trains on the sidings in the Burlington Yard or SNJLRT vehicles on the main track and freight trains on the Conrail track between the Delair Bridge and Pavonia Yard is minimized because of the distance between the respective tracks. The minimum distances between (1) double track along the Shared Trackage and (2) the centerline of the main track and the segments of non-connected parallel track (identified in Section II.F, above) are generally 17 feet. In many of the limited track segments where the track centers are less than 17 feet bridge girders provide a physical barrier against encroachment and in the others NJ Transit will install appropriate intrusion detection devices. Thus, all types of possible encroachment collisions have been minimized.

Improved crash avoidance is supplemented by other features. The SNJLRT vehicles have an aggressive emergency braking rate of an average of 4.5 mph/sec through all entry speeds.

This emergency brake rate capability will enable SNJLRT vehicles to brake and decelerate rapidly to avoid potential collisions. Conventional commuter rail equipment would not provide this capability. This capability acts as a safety redundancy feature, enhancing the overall efficacy of the crash avoidance system.

(2) Crashworthiness Standards

The companion aspect of the two-tiered safety approach is the adoption of the best and highest feasible crashworthiness standards for the SNJLRT vehicles. An energy management approach was used as the basis of car structural design to achieve the objective of minimizing the risk of injury and death to train occupants. The SNJLRT vehicles will be, at a minimum, are capable of withstanding an end load of at least 1.5 times the AWO load,[15] or approximately 171,000 pounds. The cars are intended to withstand LRT to LRT collisions at speeds up to 15 mph without sustaining damage to the passenger compartment and keeping accelerations on passengers below 2g thereby reducing injuries in the SNJLRT vehicles.[16] In addition the SNJLRT vehicles have an aggressive emergency braking rate of an average of 4.5 mph/sec

[15] AWO is the weight of an empty vehicle in full running condition, generally used as the baseline for weight dependent criteria. Additional information and AW values are presented in the table below:

Weight Reference	Designation	SNJLRTS Vehicle Weight Pounds	Specification Definition
AWO	Tare	114,660	Maximum weight of SNJLRTS Car without passengers and operator, ready to run with fuel and sand
AWI	Seated	131,325	AWO plus seated passengers and operator
AW2	Full	147,773	AW1 plus standees @ 2.7 feet per passenger
AW3	Crush	154,350	AW1 plus standees @ 1.8 feet per passenger
AW4	Structural Maximum	165,375	AW1 plus standees @ 1.35 feet per passenger

Average Passenger Weight = 165 Pounds)

[16] Additional detailed information about specific crashworthiness features is attached at Exhibit D and discussed below.

through all entry speeds. In an impending collision scenario, this emergency brake rate capability will significantly reduce speeds prior to impact.

These crashworthiness standards and the particular performance characteristics of the vehicles are discussed below in greater detail as part of the specific regulatory waiver requests. Generally, however, the SNJLRT vehicle is designed to incorporate modem energy absorbing and dissipation methods as part of an overall protection system designed to protect passengers from excessive acceleration forces and to protect the passenger compartment from rupture. The use of “crush zones” and other techniques in the assembled carbody serves to provide a zone of safety for passengers and crews.

The crashworthiness characteristics of the SNJLRT vehicles are well suited to meet the primary collision risks in the SNJLRT operating environment. Accordingly, the SNJLRT vehicles’ crashworthiness characteristics will allow for operations at an equivalent level of safety.

c. *Motor Vehicle and Pedestrian Safety Along the Shared Trackage*

NJ Transit has also considered the risks related to SNJLRT vehicles and motor vehicles crossing the Shared Trackage at grade crossings. The risk associated with grade crossings on the SNJLRT system stems primarily from the large number of crossings along the Bordentown Secondary rather than from the use of SNJLRT vehicles. To minimize this risk, 41 of the public grade crossings along the Bordentown Secondary will be fully equipped with automatically triggered gates, along with flashing lights and bells and where appropriate will be linked to adjacent traffic signals. The remaining eight (8) public grade crossings have bells, flashers and constant warning time track circuits and will be integrated with a fully signalized intersection.

The trigger equipment is designed to provide a constant warning time to road-users, regardless of the approach speed of the rail traffic. This constant warning time will reduce the inclination of road users driving around the gates. In addition, as noted above, each crossing will be constructed in accordance with a design approved by the NJDOT. The grade crossing signal systems will be operated and maintained in accordance with FRA's grade crossing safety regulations. NJ Transit thus believes that the risk of collisions at these crossings will be minimized to the extent possible.

The Policy Statement indicates that "[t]o the extent that shared use of the general system results in a substantial increase in the number of pedestrians crossing by foot in the path of trains" the risk of death or injury should be addressed. Policv Statement at 28239. NJ Transit recognizes the potential dangers for pedestrians, in and around stations and will take steps to minimize the risk to SNJLRT patrons and to limit trespasser access to the Shared Trackage in and near stations to the same extent that NJ Transit does for its conventional commuter railroad operations.

C. **Impact Of Waivers Sought**

In the Policy Statement, FTA and the FRA recognize the importance of shared use of railroad rights-of-way such as the Bordentown Secondary. FTA and FRA recognize that transit systems such as SNJLRT "promote more livable communities by serving those who live and work in urban areas without adding additional congestion to the Nation's crowded highways." Policv Statement at 22838. Shared use such as that to be provided by the SNJLRT system allows communities to "take advantage of underutilized urban freight rail corridors to provide service that, in the absence of existing right-of-way, would be prohibitively expensive." Id. In like fashion, FRA and FTA explain that "expansion of rail passenger transportation promises significant benefits to America's communities in terms of reduced highway congestion, reduced pollution, lower commuting times, and increased economic opportunities." Policy Statement at 22839.

Granting this Petition will have many benefits for consumers, the private sector, and federal, state and local governments. Shared track use allows for cost-effective investment and management of limited public funds and increases the benefits to the community and nation related to personal mobility and goods movement. Moreover, in this instance, sharing the SNJLRT corridor is the only way tc meet the needs of the freight operator, NJ Transit, the state, and freight shippers.

Burlington, Camden and Mercer counties, which are in the immediate area to be served by the SNJLRT system, are among the fastest growing counties in the nine-county Philadelphia Metropolitan Region. By 2010, population in this three county area is projected to increase 16 percent. Over the same period, the number of automobiles will expand by 35 percent and jobs will grow by 30 percent.[17] Absent sound transportation planning and development, the continued dispersion of residential development, employment growth and increased auto ownership and automobile trips will together cause the regional network of highways to be burdened beyond capacity. The opportunities for highway expansion in this region are already limited by the current land use patterns. The SNJLRT system will also aid the region's Clear Air Act mandates. The SNJLRT system is in a non-attainment area for ozone and CO (Carbon Monoxide). It is estimated that the system will reduce the amount of carbon monoxide emissions in the region by

[17] The above growth statistics are as reported by the Delaware Valley Regional Planning Authority, the municipal planning organization for this region.

23 tons per year. The system is projected to reduce energy consumption by 33.526 million BTU's per year by 2020. There will be no significant costs to the private sector, consumers, or to federal, state or local governments as a result of this waiver.

The project will encourage the re-development of compact town centers along the rail line rather than the suburban sprawl that likely would otherwise occur. Suburban sprawl does not allow for the efficient use of mass transit, thus perpetuating the increase in single occupancy vehicles. By providing efficient mobility on the rail line, both residents and businesses tend to concentrate around station areas.

This project is estimated to attract over 16,000 daily trips by the year 2020. This will almost triple the number of transit riders in the region. The direct transportation benefit of this project is estimated to be more that $24 million annually by the above date. An important benefit affecting overall safety in the region is the transfer of automobile users to transit. Fatality rates of automobile users are over 30 times that for transit users and it has been estimated that $5 1 million will be saved annually by 2020 as a result of this transfer. The system is also designed to provide access to a number of existing and projected activity centers, including the Camden Waterfront Entertainment Center, the State Aquarium in Camden, Rutgers University, and Trenton's new baseball park and ice hockey and basketball arena. Additional public benefits from the project include annual savings of 265,000 hours of travel time the first five years of service, and annual savings of 600,000 hours of travel time by 2020; and improved mobility for economically or physically disadvantaged individuals and groups. The light rail vehicle with its low floor and other ADA compliant features, coupled with NJ Transit's fare policy, will provide a fast and convenient method for disadvantaged groups to access jobs, cultural events, and local town centers. In addition, the intermodal connections at Trenton's Northeast Corridor station and the Walter Rand Transportation Center in Camden will provide access to Philadelphia, Princeton, New Brunswick, Newark Airport, Newark, New York and corridor destinations beyond. The proposed project will replace existing jointed track (with its attendant noise and vibration impacts on surrounding communities) with continuous-welded rail and signalization of the right-of-way for the first time.

D. Waiver Requests by Part

1. Part 221

a. *Section 221.13(a) - Marking Device Display; Section 221.14(a) - Marking Devices*

(1) FRA Requirement and Purpose

Section 221.13(a) requires each train that occupies or operates on main line track be equipped with a display on the trailing end of the rear car of that train, and continuously illuminated or flashing a marking device as prescribed in that subpart. Section 221.14(a) requires that passenger, commuter and freight trains be equipped with at least one such compliant marking device, which has been approved by FRA in accordance with the procedures included in Appendix A of Part 221, and which has specific intensity, beam arc width, color and flash rate characteristics. The requirements are intended to reduce the likelihood of rear-end collisions attributable to the inconspicuity of the rear-end of a leading train.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver from this requirement because the SNJLRT vehicle will be equipped with marking devices such as headlights, brake, tail, turn signal, clearance and marker lights, and reflectors similar to those required for highway vehicles as contained in NJDOT regulations. The NJDOT regulations adopt and incorporate by reference the Federal highway Administration's ("FHWA") Federal Motor Carrier Safety Regulations found at 49 CFR Part 393. The external illumination consists of a set of front headlights, turn signals, tail and brake lights, reflectors, clearance, and marker lights at each end of the bi-directional SNJLRT vehicles. One headlight is mounted next to each brake light, with the headlights capable of being switched from low to high beam. Turn signal lights are visible from both the front and the side of the vehicle. The mouting height and candela value of the lights provided is consistent with the FHWA requirements for commercial motor vehicles, 49 CFR Part 393.

The SNJLRT vehicle exterior lighting was designed to match state highway vehicle requirements instead of FRA regulations because the SNJLRT vehicles will operate in two different environments: in streets running mixed with motor vehicle traffic and in a conventional railroad corridor. FRA-compliant rail car marker devices might not provide sufficient information to motor vehicle drivers and, therefore might be inappropriate for the in-street portion of the SNJLRT system. The SNJLRT specifications on the other hand, will provide a higher level of safety for m-street operations.

NJ Transit believes that safety on the conventional railroad corridor will not be compromised by the use of the SNJLRT marking devices. The SNJLRT vehicle will have tail and brake light and clearance lights to define the end contour of the vehicle, substantially similar to the marking devices required by FRA regulations. Any variation in illumination levels between SNJLRT vehicles and Conrail trains is not material because of the temporal separation of the operations. A waiver of Sections 221.13(a) and 221.14(a) is justified, because the exterior lighting of the SNJLRT vehicle offers superior safety on in-street operations and equivalent safety on conventional railroad corridor operations.

2. Part 223

a. *Section 223.9(c) - Glazing Requirements*

(1) FRA Requirement and Purpose

Section 223.9(c) requires that passenger cars, including self-propelled passenger cars built or rebuilt after June 30, 1980, be equipped with FRA certified glazing in all windows. This requirement is intended to reduce the likelihood of injury to passengers and/or employees from breakage and shattering of windows (including windshields).

(2) Requestfor Waiver and Safety Justification

NJ Transit requests a waiver of this requirement for windows other than cab windshields'[18] because those windows will conform to the side impact requirements of ANSI 226.1, Table 1, item 1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways." The referenced standard is attached hereto as Exhibit H. Glass meeting this standard is break-resistant in normal usage, but can be broken with a standard rescue tool, such as a pry bar (a pry bar will be located near side windows in each SNJLRT vehicle) in an emergency. Upon breaking, the glass "crumbles" into pebble-like pieces, posing no significant hazard to passengers, employees or rescue personnel. The use of such safety glass windows is standard throughout the rail transit industry for (among other applications) in-street light rail operations, where it has proved both durable and safe. In addition, the risk associated with vandalism (such as by rocks thrown

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[18] The cab windshields of the SNJLRT vehicles will be manufactured in compliance with the FRA glazing standards.

against the windows) is addressed from an operations standpoint in the SSPP. See the discussion at Section II.G., above. There is no reason to believe that the SNJLRT vehicle windows will pose any safety hazard in conventional railroad corridor operations. The requested waiver with respect to Section 223.9(c) is justified, because the side windows of the SNJLRT vehicle offer necessary safety on in-street operations and equivalent safety on conventional railroad corridor operations.[19]

b. *Section 223.9(d) -Emergency Exit Window Markings*

(1) FRA Requirement and Purpose

Section 223.9(d) requires that each emergency window be conspicuously and legibly marked with luminescent material on the inside of each car and that clear and legible operating instructions be posted at or near each such window. This section also requires that each window intended for access by emergency responders for extrication of passengers be marked with a retroreflective, unique and easily recognizable symbol or other clear marking and that clear and understandable window-access instructions be posted at each such window or at the end of each car. These requirements are intended to distinguish emergency windows from other windows and provide information on the operation of the emergency windows.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver from these requirements because all side windows on the SNJLRT vehicles are suitable for use in the event of an emergency and therefore, it would make

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[19] Section 223.17 requires each passenger car that is fully equipped with FRA compliant glazing material to have a notice of compliance stenciled on an interior wall of the car. This serves the purpose of providing notice about the glazing material in the car. NJ Transit also requests a waiver of this requirement. NJ Transit will place stenciling in the SNJLRT vehicles providing notice of the FRA-compliant windshields and the ANSI standard compliant side windows,

no sense and could prove to be a confusion hazard to mark any particular side windows as designated "emergency windows." All side windows are made of safety glass and are fitted into the sidewalls by large, specialized rubber sections. All of these windows can be broken with standard rescue tools and can function as emergency windows if necessary. Pry bars, which can be used to break windows if necessary, will be located near side windows inside each SNJLRT vehicle. Instructions meeting FRA requirements and clearly indicating *that the* pry bar can be used to break any side window will be posted adjacent to each pry bar. Thus, identification of some windows as "emergency windows" and the posting of special operating instructions is not appropriate in this instance and is not necessary for safe emergency egress from the SNJLRT vehicle. Enforcing the marking requirements would not serve the intended safety purpose. Accordingly, a waiver of Section 223.9(d) is justified.

c. *Section 223. 15(c) - Emergency Window Requiremen ts*

(1) FM Requirement and Purpose

Section 223.15(c) requires each passenger train car to be equipped with at least four emergency windows designed to permit rapid and easy removal during an emergency. This requirement is intended to enhance safety by providing emergency egress in addition to egress through vehicle doorways.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT vehicles will not be manufactured with designated emergency windows. The vehicles, however, are designed to permit equivalent or superior emergency exit options. Each vehicle has 10 windows on each side, all of which are made of safety glass and are fitted into the sidewalls by large, specialized rubber sections. All of these windows are large (approximately 42 by 36 inches) when compared with conventional commuter rail cars, can be broken with standard rescue tools and can function as emergency windows if necessary.

Furthermore, the SNJLRT vehicle doorways provide greater access/egress capability than is found on conventional commuter rail cars. Each vehicle has two sets of double doors on each side of the vehicle. The minimum clearance height of each doorway is 76 inches and the flow lane width of each doorway is at least 24 inches (48 inches in total for each set of double doors). The vehicle is designed such that the egress time of an AW2 load shall not exceed 120 seconds, calculating egress assuming a flow rate of 2 seconds per passenger per flow lane. The doors are releasable through an emergency reiease lever located on the inside of each doorway and for at least one doorway per side on the outside of the vehicle. This will enable a closed and interlocked door to be lock-released without power supply. Activation of the emergency release levers shall allow the door leaves to be manually operated. The interior door release levers shall be clearly marked and in a location accessible to all passengers, compliant with ADA and FRA marking requirements. These release lever features will enable quick and easy opening of the doors by passengers, equivalent to FRA emergency exit window requirements.

The doorways are designed to provide the main means of emergency access/egress and because the large windows can function as additional emergency access/egress points, there is very little risk of passengers becoming trapped or rescue personnel being unable to reach passengers. In addition, the SSPP will contain detailed emergency response plan requirements which will include passenger evacuation and crowd control planning. See the discussion at Section III.D.6., below Accordingly, a waiver of Section 223.15(c) is justified.

3. Part 229

a. *Section 229.125 - Headlights and Auxiliary Lights*

(1) FRA Requirement and Purpose

Sections 229.125(a) and (d) require locomotives to have headlights of specified candela brightness, and auxiliary lights of specified brightness and placement on the vehicle. The purpose of these requirements is to reduce the risk of collisions attributable to inconspicuity of the train, particularly in low light level situations.

(2) Request for Waiver and Safety Justification

NJT requests a waiver from these requirements because the SNJLRT vehicles will have lights similar to those required by state law applicable to commercial motor vehicles. See the discussion of the NJDOT regulations in Section III.D. 1 .a(2). The SNJLRT vehicles will be equipped with two headlights on the leading cab of the train capable of illuminating a person 500 feet away. In addition, the vehicles will have an auxiliary light on the front of the car that will form a triangular pattern with the headlights to present a distinctive profile to motor vehicle drivers approaching grade crossings.

The use of lighting similar to motor vehicle lighting is desirable because the SNJLRT vehicle operates in two distinctly different environments. One portion is on mainline railroad track and the other is streetrunning mixing with highway traffic. NJ Transit believes that while the SNJLRT lighting arrangement will provide for sufficient light to provide safety along the railroad right-of-way, the FRA lighting requirements may not be appropriate for the street-running portions of the route. However, since the front of the vehicle will have headlights and auxiliary lighting to define the end contour of the vehicle, the conspicuity of the train will be assured in both the Shared Trackage and street-running portions of the route and any effect of variations in illumination levels will be minor. Accordingly, a waiver of Sections 229.125(a) and (d) is justified.

4. Part 231

a. *Section 231.14 - Passenger Cars without End Platforms*

(1) FRA Requirement and Purpose

Section 23 1.14 specifies the requisite location, number, dimensions, and manner of application of a variety of railroad car safety appliances (e.g., hand brakes, ladders, handholds, steps), directly implementing a number of statutory requirements found in 49 U.S.C. §§ 20301 - 05.

The statute contains specific standards for automatic couplers, sill steps, hand brakes, and secure ladders and running boards. Where ladders are required, the statute mandates compliant handholds or grab irons for the roof of the vehicle at the top of each ladder. Compliant grab irons or handholds also are required for the ends and sides of the vehicles, in addition to standard height drawbars. In addition the statute requires trains to be equipped with a sufficient number of vehicles with power or train brakes so that the engineer may control the train's speed without the use of a common hand brake. At least 50 percent of the vehicles in the train must be equipped with power or train brakes and the engineer must use the power or train brakes on those vehicles and all other vehicles equipped with such brakes that are associated with the equipped vehicles in the train.

Aside from the statutory-based requirements, the regulations provide additional and parallel specifications for hand brakes, sill steps, side handholds, end handholds, end handrails, side-door steps and uncoupling levers. More specifically, each passenger vehicle must be equipped with an efficient hand brake that operates in conjunction with the power brake on the train. The hand brake must be located so that it can be safely operated while the passenger vehicle is in motion. Passenger cars must have four sill steps and side-door steps and prescribed tread length, dimensions, material, location and attachment devices for sill steps and side-door steps. In addition, there are requirements for the number, composite material, dimensions, location and other characteristics for side and end handholds and end handrails. Finally, this section requires the presence of uncoupling attachments that can be operated by a person standing on the ground.

These very detailed regulations are intended to ensure that sufficient safety appliances are available and that they will function safely and securely as intended.

(2) Request for Exemption and/or Waiver and Safety Justification

As noted above, some of the requirements in Section 23 1.14 are required by statute and, therefore, are not subject to waiver under FRA's regulatory waiver provisions. FRA does, however, have the statutory authority to provide exemptions from these statutory requirements. 49 U.S.C. § 20306. Consequently, NJ Transit requests exemption from and/or waiver of these requirements, as appropriate, because the SNJLRT vehicles will be equipped with their own array of safety devices resulting in equivalent safety. These are discussed in greater detail below.

The SNJLRT vehicle has a number of features that provide an equivalent or superior level of safety as compared to a conventional hand brake. Each SNJLRT vehicle will be equipped with a parking brake located in each of the two control stands in each vehicle. The brake is capable of holding the vehicle on a gradient of six percent at an AW1 (60 tons) load. The SNJLRT vehicles will be operated by a one-person crew. The SNJLRT vehicle will be either one or two vehicles. The train will be operated from the control stand in the lead cab, on trains consisting of two cars, and from the front of the single vehicle in the case of a one vehicle train. During normal operating conditions, the operator will make all service and parking brake applications. In the event of an emergency, the SNJLRT vehicle will have several features which would permit passengers to activate the braking system. First, an emergency release device located on each passenger door pillar causes an irrevocable application of the service brakes in the event of any application. Second, the four doors (two on each side of each vehicle) are interlocked with the propulsion system to ensure that the SNJLRT vehicle does not move while any doors are open and the opening of the doors while the SNJLRT vehicle is in motion will cause an irrevocable application of the service brake. The braking characteristics of the SNJLRT vehicle will result in a shorter full service brake activation tune and easier brake application than would be achieved by the presence of a traditional hand brake. Thus, the safety purpose of the hand brake requirement is achieved, but in a manner that provides an equivalent or superior level of safety.

Sill steps and side-door steps are not necessary for safety on the SNJLRT vehicle, because it is a low floor vehicle designed for level boarding. The door threshold is 22.4 inches above the top of the rail. This configuration of the doors renders sill steps and side-door steps unnecessary. Compliance with the sill step and side-door step requirements would not enhance the safety of the vehicle.

Handholds and handrails are typically intended for use by conductors and crew members performing service and yard duties. However, SNJLRT operations will not involve any service and yard duties from positions outside and adjacent to the vehicle or near vehicle doors. Yard moves will be controlled from the cab stand by the on-board operator and switches will be thrown remotely or through local controls initiated by the on-board operator. Therefore, there is no need for personnel to mount or dismount the vehicle using external appliances of any kind and no need for handholds or handrails on SNJLRT vehicles. NJ Transit has reservations about installing external handholds and handrails because of the street-running characteristics of part of the SNJLRT service. External handholds or handrails would give pedestrians the opportunity to grab onto something on the outside of the vehicle with the intention to get a ride. This is unsafe and the SNJLRT vehicle will be designed to minimize the opportunity for this practice. In sum, there is no practical need for handholds or handrails and their presence might constitute a safety hazard in the street-running operating environment.

The SNJLRT vehicle will be equipped with a fully automatic electric coupler controlled from the operator's position in the cab and a mechanical coupler at each end. The coupler and associated draft gear system will have a centering device that retains the unconnected coupler head within its gathering range. The couplers are central buffer couplings with electrical and pneumatic coupling. The operator will initiate uncoupling from the cab stand and no external crew is required to assist in this operation. NJ Transit believes that performing all coupling/uncoupling from inside the vehicle will enhance safety. This elimination of the need for frequent coupling/uncoupling of vehicles, combined with ability for such activity to take place without crew members in close proximity to the coupler mechanisms eliminates the need for specially placed uncoupling levers and any hazard associated with manual coupling.

The SNJLRT vehicles will use dynamic brakes. The dynamic brakes will be supplemented by friction brakes and track brakes. NJ Transit will require regular inspections, testing, maintenance and operation of the brake equipment on the SNJLRT vehicle as required by Section 5 of the NJDOT SSPS. Sec Exhibit G. Specific operational procedures and inspection testing and maintenance intervals and protocols will be set forth in the SSPP. Therefore, the SNJLRT vehicle brake system will be equivalent to a standard air brake system and thus provide an equivalent level of safety.

NJ Transit is aware that it may obtain exemption from the statutory safety appliance requirements mentioned above only if application of such requirements would "preclude the development or implementation of more efficient railroad transportation equipment or other transportation innovations." 49 U.S.C. § 20306. The exemption for technological improvements was originally enacted to further the implementation of a specific type of freight car, but the legislative history shows that Congress intended the exemption to be used elsewhere so that "other types of railroad equipment might similarly benefit." S. Rep. 96-614, at 8, (1980), reprinted in 1980 U.S.C.C.A.N. 1156, 1164.

FRA has recognized the potential public benefits of temporally separated transit use on segments of the general railroad system. Light rail transit systems "promote more livable communities by serving those who live and work in urban areas without adding congestion to the nation's overcrowded highways." Policy Statement at 28238. They "take advantage of underutilized urban freight rail corridors to provide service that, in the absence of the existing right-of-way, would be prohibitively expensive." Id. There have been many technological advances in types of equipment used for passenger rail operations, such as the use of light rail transit vehicles that will be used for the SNJLRT System. Light rail transit equipment is energy-efficient for passenger rail operations because it is lighter than conventional passenger equipment. Light rail vehicles are able to quickly accelerate or decelerate, which makes them more suitable than other equipment types in systems with closely-configured stations. Denying NJ Transit's request for an exemption from certain safety appliance requirements, would preclude the implementation of light rail transit for shared use/temporal separation operations. Moreover, compliance with the statutory requirements is not necessary for safe operations.

With regard to the regulatory requirements of Section 23 1.14, as discussed above, the SNJLRT vehicles will be equipped with safety appliances that are more appropriate for light rail transit vehicles, thus achieving an equivalent or superior level of safety in the SNJLRT operating environment.

Accordingly, exemption from the statutory safety appliance standards and waiver of the requirements of Section 23 1.14 is justified.

5. **Part 238**

a. ***Section 238.113 -Emergency Window Exits***

(1) FM Requirement and Purpose

Section 238.113 requires passenger cars to have a minimum of four emergency exit windows, either in a staggered configuration or with one located at each end at each side of the car. Each window must have a minimum unobstructed opening with dimensions of 26 inches horizontally and 24 inches vertically. Each emergency exit window must be easily operable without requiring the use of a tool or other implement. This requirement is intended to provide for sufficient, easily accessible avenues of egress from passenger cars in the case of emergency.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT vehicles do not come equipped with emergency exit windows. The cars, however, are designed to permit sufficient equivalent egress that passengers will not become trapped in the cars in the case of emergency. See also the discussions related to emergency egress and emergency planning in Section III.D.2.c, above, and III.D.6., below. Accordingly, a waiver of Section 238.113 is justified.

b. *Section 238.115(b)(4) -Emergency Lighting*

(1) FRA Requirement and Purpose

Section 238.115(b)(4) requires passenger cars to provide battery powered emergency lighting with a 90-minute back-up power system capable of operating without a loss of more than 40% minimum illumination levels in all equipment orientations within 45° of the upright and vertical position and capable of operating after the initial shock of a collision or derailment resulting from prescribed individually applied accelerations. The purpose of these requirements is to ensure that in an emergency situation, sufficient lighting will remain available to aid passengers, crew members and rescue personnel to access and leave the train safely.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of these requirements because power for the emergency lighting is provided by a battery with sufficient capacity to sustain emergency loads, including the above lighting, and radio and public address systems, for a period of at least one hour. Additionally, the battery will have sufficient capacity to sustain power to door controls, propulsion and brake controls, coupler control and the horn and bell for a period of at least one hour. The battery is located in the central power unit, removed from the front of the vehicle where direct collisions may occur. The battery is designed for transit use which requires a rugged design capable of withstanding reasonable shock and vibration. The batteries mountings are designed to withstand not less than 5.0 g in the longitudinal direction, 2.0 g in the lateral direction and 3.0 g in the vertical direction.

The SNJLRT vehicles will operate in a urban/suburban region; the route is at-grade with many points of easy access for emergency rescue units from adjacent streets. In most locations, emergency responders can reach the SNJLRT system within 15 minutes. Even on the most remote section of the system, a three-mile stretch along Duck Island, emergency responders could reach the system within sixty minutes. Additionally, the headway between SNJLRT vehicles is no more than thirty minutes and each vehicle has the capability of acting as a rescue car by coupling with a failed unit and moving it to the next stop for detrainment of passengers. The rescuing car can supply sufficient electrical power to the failed vehicle for the emergency lighting and other functions. In the event that the last scheduled vehicle in a day lost power, the previous vehicle would be returned to recover the failed vehicle.

The SNJLRT main and backup lighting and power systems will provide necessary and adequate functioning in the SNJLRT operating environment. Accordingly, a waiver of Section 238.115(b)(4) is justified.

c. *Section 238.203 - Static End Strength*

(1) FM Requirement and Purpose

Section 238.203 provides for the overall compressive strength of rail passenger cars, requiring them to have a minimum static end strength of 800,000 pounds on a line of draft at the ends of occupied volumes without permanent deformation of the car body structure. This section is intended to prevent sudden, brittle-type failure of the main structure of a passenger car, thereby providing protection of occupants in the case of a crash.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver from this requirement because the SNJLRT vehicle will be designed to attain a sufficient level of safety in the SNJLRT operating environment. The strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of a collision between a SNJLRT vehicle and a Contrail train, obviating the need for SNJLRT equipment to meet conventional railroad car structural standards. Instead, the SNJLRT vehicles are designed to withstand collisions with other light rail vehicles, motor vehicles and similar objects. Relevant aspects of these design standards are described below.

As noted above, the SNJLRT collision avoidance system is at the heart of the SNJLRT safety design. Marked by complementary elements such as operating rules and procedures, train control technology and the SNJLRT signal system, the collision avoidance system will significantly reduce the likelihood of collisions involving SNJLRT vehicles. Moreover, the SNJLRT vehicle's rapid deceleration design features will work to further reduce the prospect of collisions and to significantly reduce the closing speed, and accordingly, the seriousness of collisions that do occur.

Above and beyond the crash avoidance features of the SNJLRT System, the SNJLRT vehicles are designed to prevent sudden, brittle-type failure of the main structure of a passenger car. The vehicle design accommodates the actual progression of a failure induced by a sudden collision phenomenon; from the elastic limit, through the plastic limit, to a brittle failure. NJ Transit requires the SNJLRT vehicles to be manufactured to comply with the standards set forth in Exhibit E, summarized below:

1. The passenger compartment will be capable of sustaining, without any permanent deformation, at least 1.5 AWO longitudinal loads (approximately 171,000 pounds) applied uniformly at the ends of the passenger compartment, with a uniformly distributed AW4 vertical load (approximately 165,375 pounds).
2. With the vehicle uniformly loaded to AW4, the end sill structure will be capable of:
   - sustaining loads up to the peak collapse load of the crush zone without permanent deformation;
   - sustaining the reaction loads generated from the loads specified for collision posts, comer posts and anti-climbers without permanent deformation; and
   - distributing the collision loads incurred during scenarios specified for crashworthiness, such that the collapse of the energy absorption elements in the crush zones is the primary failure mode.
3. Vehicles will be capable of withstanding collisions with other SNJLRT vehicles, motor vehicles, or overtravel buffers without unnecessary risk of injury to passengers

or excessive damage to SNJLRT cars and/or track equipment. In a collision, no passenger compartment shell will rupture or suffer any opening through which passengers' limbs may protrude; no compartments within the engine compartment will become dislodged and penetrate into the passenger compartment; high voltage devices and associated connecting cables will remain contained and will not create electrical shock hazards to personnel; and electrical and diesel systems will not create a fire hazard.

To achieve the objective of crashworthiness, a crash energy management approach was used as the basis of the SNJLRT vehicle's structural design. Further, as it is expected that during peak hours that some passengers will stand, it was deemed important to minimize the deceleration of passengers in the event of a frontal collision. In a collision between a SNJLRT vehicle moving at speed V and a stationary SNJLRT vehicle (i) both consists on level tangent track and unbraked, (ii) couplers fully engaged, (iii) either SNJLRT vehicle either one or two vehicles (i.e. the normal consist for comprising cars normally used in revenue service), and (iv) any SNJLRT vehicle having a weight of AWO (114,600 pounds):

TABLE III-2

VELOCITY	CRASH ENERGY MANAGEMENT
$V \leq 5$	No damage to any SNJLRT car or equipment, and the maximum longitudinal acceleration measured in any passenger compartment will not exceed 1 .0g.
$5 < V \leq 15$	Damage confined to the expendable energy absorption devices and sacrificial structural members at the ends of the SNJLRT cars, which will be repairable. The primary structure enclosing the passenger compartment(s) will remain intact, with no permanent deformation of any of its members. The maximum longitudinal acceleration measured in any passenger compartment will not exceed 2 g.

In addition to the above, the SNJLRT cars have an aggressive emergency deceleration rate of an average of 4.5 mph/sec through all entry speeds. In an impending collision scenario this emergency brake rate capability has the potential to reduce speeds prior to impact.

The SNJLRT crash avoidance system combined with the above stated specifications, will provide equivalent protection to occupants in the case of a crash in the SNJLRT operating environment. Accordingly, a waiver of Section 238.203 is justified.

d. *Section 238.205 (a) - Anti-climbing Mechanism*

(1) FRA Requirement and Purpose

Section 238.205 (a) requires locomotives (as defined in § 238.5) to have forward and rear end anti-climbing mechanisms capable of resisting an upward or downward vertical force of 200,000 pounds without failure. These requirements are intended to prevent override or telescoping of one passenger train unit into another in the event of high compressive forces caused by a derailment or collision.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT vehicle will be designed so that: with only two ribs of the anticlimbing mechanism engaged, and a vertical load of ± 40,000 pounds combined with a longitudinal compressive load of AWO applied at the carbody centerline, there will be no permanent deformation of the carbody structure. In addition, crush elements within the couplers are able to absorb a certain amount of energy in recoverable energy absorption elements. When this occurs, the coupler moves back until the anti-climbers of the colliding vehicles touch and the loads are taken by the carbodies directly. Anti-climbers are fitted to the front end of the cars to avoid telescoping.

While individual structural elements will not conform to the requirement of Section 238.205(a), the assembled carbody uses "crush zones" and other techniques to protect passengers in the event of collisions. Specifically, the SNJLRT vehicle is designed using advanced computer methods to incorporate modem energy absorbing and dissipation methods to dissipate energy and transfer loads and protect the passenger compartment. The anti-climbers and energy absorption mechanisms are designed to limit the potential for override and under-ride and prevent telescoping. The SNJLRT vehicle design will achieve the uniformity of end structure deformation essential to this objective. Moreover, because the strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of SNJLRT vehicle/Conrail train collisions, there is no need for the SNJLRT vehicles to meet the more stringent requirements applicable to conventional railroad equipment.

The standard to which the SNJLRT vehicle is manufactured will prevent override or telescoping and provide an equivalent level of safety as that provided by the FRA rule. Accordingly, a waiver of Section 238.205 is justified.

e. ***Section 238.207 - Link Between Coupling Mechanism and Car Body***

(1) *FRA Requirement and Purpose*

Section 238.207 requires the link between the car coupling mechanism and the car body to be designed to resist a vertical downward thrust from the coupler shank of 100,000 pounds for any normal horizontal position of the coupler, without permanent deformation. The purpose of this requirement is to avoid a premature failure of the draft system so that the anticlimbing mechanism will have an opportunity to engage.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver from this requirement because the SNJLRT vehicle has its own design features to accomplish the purpose of the requirement. As noted above, the strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of a collision between a SNJLRT vehicle and a Contrail train, obviating the need for SNJLRT equipment to meet conventional railroad car structural standards. Instead, the SNJLRT vehicles are designed to withstand collisions with other light rail vehicles, motor vehicles and similar objects. Relevant aspects of these design standards are described below.

The SNJLRT vehicle will be designed so that the carbody structure supporting the coupler will sustain without permanent deformation a load that is equal to 110 percent of the coupler release load (if applicable) or failure load applied at the coupler brackets, with a uniformly distributed AW4 (165,375 pounds) vertical load. In addition, the method of attaching the coupler to the coupler anchor bracket(s) will allow the coupler to become fully released from the coupler anchor bracket(s) once the coupler has absorbed its maximum design energy. The coupler will be contained and prevented from coming in contact with the track or from protruding into the passenger compartment. The coupler and draftgear will withstand an operating consist with an AW3 (154,350 pounds) passenger load, pushing or pulling an unpowered consist with an AW3 passenger load, over all grades and curves on SNJLRT Line, without damage to the coupler.

The intent of the SNJLRT vehicle design is to prevent the coupler shank from contributing to potential damage during a frontal collision. The approach taken is to release the coupler from mechanical connection to the carbody once it has absorbed its maximum design energy. When this occurs the coupler assembly is separated from the coupler anchorage on the car structure. The coupler is retaincd to prevent it from coming into contact with the track or from protruding into the passenger compartment. This feature is provided to reduce the risk of derailment and penetration of the occupied space.

These design standards will allow the SNJLRT vehicle to meet a level of safety equivalent to Section 238.207. Accordingly, a waiver of Section 238.207 is justified.

f. *Section 238.209 - Forward-Facing End Structure of Locomotives*

(1) FRA Requirement and Purpose

Section 238.209 requires the skin of the forward-facing end of each locomotive to be equivalent to a 1/2 inch steel plate with a 25,000 pounds per square inch yield strength; designed to inhibit the entry of fluids into the occupied cab area of the locomotive; and be affixed to the collision posts or other main vertical structural members so as to add to the strength of the end structure. These requirements are intended to provide protection to persons in the occupied area of the locomotive cab.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of the requirements in this section because the SNJLRT vehicle will be designed to attain a sufficient level of safety in the SNJLRT operating environment. As noted above, the strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of a collision between a SNJLRT vehicle and a Contrail train, obviating the need for SNJLRT equipment to meet conventional railroad car structural standards. Instead, the SNJLRT vehicles are designed to withstand collisions with other light rail vehicles, motor vehicles and similar objects. Relevant aspects of these design standards are described below.

As noted above, the SNJLRT collision avoidance system is at the heart of the SNJLRT safety design. Marked by complementary elements such as operating rules and procedures, train control technology and the SNJLRT signal system, the collision avoidance system will significantly reduce the likelihood of collisions involving SNJLRT vehicles. Moreover, the SNJLRT vehicle's rapid deceleration design features have the potential to mitigate the prospect of collisions and to significantly reduce the closing speed, and accordingly, the seriousness of collisions that may occur.

In addition, the SNJLRT system provides improved grade crossing protection for the operator, passenger and vehicle through the use of the crossing warning indicators which alert the operator to the gate function and status. These indicators are comprised of lunar white aspects, visible to the vehicle operator from at least a normal service braking distance from the crossing. A flashing indication shall be given at any time when the gates are operating and between fully down and up positions. When the gates are fully down the indication shall be steady. The operator can respond accordingly if a malfunction is observed.

With respect to the specific design of the forward-facing end structure, the SNJLRT vehicle is similar to a push-pull cab configuration. The operator's cab floor height is 44" and the vehicle provides 17 1,000 pounds of buff strength.

NJ Transit believes that the SNJLRT vehicle, along with the other system safety design features, will provide an equivalent level of safety. Accordingly, a waiver of Section 238.209 is justified.

g. *Section 238.211 - Collision Posts*

(1) FRA Requirement and Purpose

Section 238.211 requires loscmotives to have two full-height collision posts at each end where coupling and uncoupling are expected. Each collision post must have an ultimate longitudinal shear strength of not less than 500,000 pounds at a point even with the top of the underframe member to which it is attached and a longitudinal shear strength of not less than 200,000 pounds exerted at 30 inches above the joint of the post of the underframe. Alternatively, cars may be constructed with an end structure that can withstand the sum of forces that each collision post is required to withstand. This requirement is intended to provide for protection against crushing of occupied areas of passenger cars in the event of a collision or derailment.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT vehicle will have collision posts or a structural equivalent, protecting at least the area between the under&me and the bottom of the windshield. NJ Transit believes the SNJLRT vehicle design will provide an adequate measure of safety. The strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of a collision between a SNJLRT vehicle and a Contrail train, obviating the need for SNJLRT equipment to meet conventional railroad car structural standards. Instead, the SNJLRT vehicles are designed to withstand collisions with other light rail vehicles, motor vehicles and similar objects. Relevant aspects of these design standards are described below.

As noted above, the SNJLRT ‘collision avoidance system is at the heart of the SNJLRT safety design. Marked by complementary elements such as operating rules and procedures, train control technology and the SNJLRT signal system, the collision avoidance system will significantly reduce the likelihood of collisions involving SNJLRT vehicles. Moreover, the SNJLRT vehicle's rapid deceleration design features will work to further reduce the prospect of collisions and to significantly reduce the closing speed, and accordingly, the seriousness of collisions that do occur.

In order to preclude sudden catastrophic failure or telescoping of SNJLRT cars, all connections which attach collision posts, comer posts and structural shelf to each other and/or the underframe structure and roof structure, will be made in such a manner to develop the full strength of the load bearing members in shear. The ultimate shear strength of the collision posts will be not less than a compression load of AWO (114,660 lbs) applied at the top of the underframe, and at any angle up to ± 15° from the longitudinal axis. A compression load of 0.5 AWO (57,330 lbs) similarly applied 15 inches above the top of the underframe will cause no yielding of the collision posts. All under-floor, roof mounted and engine compartment equipment weighing more than 200 pounds will be designed to withstand not less than 5.0 g in the longitudinal direction, 2.0 g in the lateral direction, and 3.0 g in the vertical direction. These loads applied separately will not result in stresses that exceed 90 percent of the yield or buckling strength of the material.

These design requirements provide for the same type of protection of the occupant space as the FRA collision posts requirements, but do so in a way consistent with the design of the SNJLRT vehicle. As noted elsewhere herein, the SNJLRT vehicle is designed using advanced computer methods to incorporate modem energy absorbing and dissipation methods as part of an overall protection system designed to dissipate energy and transfer loads from impacts to protect the passenger compartment. As part of this system, the SNJLRT collision posts provide protection for the occupied volume of the vehicle shell during a collision. Thus, the SNJLRT vehicle effectively isolates passengers and crew from the hazards of penetration.

NJ Transit also notes that a portion of the SNJLRT system alignment consists of street running. To operate safely in this environment the operator requires good visibility to monitor road and pedestrian traffic around the vehicle. Conventional collision post designs may result in visual obstructions for the operator. This improved visibility is also beneficial when operating on the mainline railroad portion of the route. Accordingly, a waiver of Section 238.211 is justified.

h. Section 238.213 - Corner Posts

(1) *FRA Requirement and Purpose*

Section 238.213 requires two full-height comer posts at the end of each vehicle capable of resisting without failure a load of 150,000 pounds at the point of attachment to the underframe and a load of 20,000 pounds at the point of attachment to the roof structure. Each comer post must be able to resist a horizontal load of 30,000 pounds applied 18 inches above the top of the floor without permanent deformation. These requirements serve to provide protection to occupant compartments from side-swipe type collisions.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT vehicle will be designed to attain a sufficient level of safety in the SNJLRT operating environment. As noted above, the strict temporal separation of the SNJLRT and Conrail services virtually eliminates the risk of a collision between a SNJLRT vehicle and *a* Contrail train, obviating the need for

SNJLRT equipment to meet conventional railroad car structural standards. Instead, the SNJLRT vehicles are designed to withstand collisions with other light rail vehicles, motor vehicles and similar objects. Relevant aspects of these design standards are described below.

As noted above, the SNJLRT collision avoidance system is at the heart of the SNJLRT safety design. Marked by complementary elements such as operating rules and procedures, train control technology and the SNJLRT signal system, the collision avoidance system will significantly reduce the likelihood of collisions involving SNJLRT vehicles. Moreover, the SNJLRT vehicle's rapid deceleration design features will work to further reduce the prospect of collisions and to significantly reduce the closing speed, and accordingly, the seriousness of collisions that do occur.

The SNJLRT vehicle comer posts will have an ultimate shear strength not less than a compression load of 0.5 AWO (57,330 lbs) applied at the top of the underframe; compression load of 0.3 AWO (3,500 lbs) applied 15 inches above the top of the underframe, or at the level of the structural shelf (whichever is higher) and applied in any direction, will cause no yielding of the comer posts; any underfloor, roof mounted and engine compartment equipment weighing more than 200 pounds will be designed to withstand not less than 5.0 g in the longitudinal direction, 2.0 g in the lateral direction, and 3.0 g in the vertical direction and when these loads are applied separately they will not result in stresses that exceed 90 percent of the yield or buckling strength of the material.

Here too, while individual structural elements of the SNJLRT vehicle may not conform to the specific requirements, the assembled carbody uses "crush zones" and other energy absorption and dissipation techniques to protect passengers in the event of collisions. As part of this system, the comer posts extend from the underframe to the roof structure and may be combined with the collision posts and underframe to become part of the end structure. This design effectively isolates passengers and crew from the hazards of penetration, thereby providing protection for the occupied volume of the vehicle shell during a collision.

As noted above, a portion of the SNJLRT system alignment is in streets. To operate safely in this environment, the vehicle operator requires good visibility to monitor road and pedestrian traffic around the vehicle. Conventional comer post designs might result in visual obstructions for the operator. The superior visibility of the SNJLRT vehicle is also beneficial when operating on the railroad corridor portion of the route.

The SNJLRT vehicle specifications provide for additional structural protection of the occupant compartments, and, in conjunction with the other safety design features of the vehicle, will provide an equivalent or superior level of safety to the FM specification. Accordingly, a waiver of Section 238.213 is justified.

i. ***Section 238.215 - Rollover Strength***

(1) FRA Requirement and Purpose

Section 238.215 sets forth the structural requirements intended to prevent significant deformation of the occupant compartments of passenger cars, in the event the car rolls onto its side or roof. Under this section, a passenger car must be able to support twice the dead weight of the vehicle while the vehicle is resting on its roof or side.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT is designed such that the roof will have sufficient strength to support, without permanent deformation, concentrated loads of 250 pounds per person as applied by a person walking on the roof, with a maximum of three persons at any time. As noted above, the under-floor, roof mounted and engine compartment equipment weighing greater than 200 pounds will be designed to withstand not less than 5.0 g in the longitudinal direction, 2.0 g in the lateral direction, and 3.0 g in the vertical direction and when these loads are applied separately, they will not result in stresses that exceed 90 percent of the yield or buckling strength of the material. With a compression load of 40,000 pounds applied to the side wall at the side sill, and distributed along 8 feet, and a compression load of 10,000 pounds applied to the side wall at the belt rail, there will be no yielding or buckling of the carbody structure.

The features specified above are designed to enhance crashworthiness and protect the occupied volume. The SNJLRT vehicle incorporates a lightweight low floor design, which lowers the center of gravity as well as the load conditions in rollover circumstances. The lower center of gravity makes the SNJLRT vehicle less prone to rollover than a standard commuter rail car. Moreover, in the unlikely event of a rollover, the lighter weight of the SNJLRT car means that the roof does not have to support as much weight as would a standard commuter rail car. In addition, the bulk of the equipment including the propulsion system and powered truck are located in the articulated center segment of the vehicle and pose no direct hazard to passengers in the event of a rollover.

In the unlikely event that a Derailment leading to a rollover occurs, the SNJLRT vehicle specifications provide for structural protection of the occupant compartments and, in conjunction with the other safety design features of the vehicles, will provide an equivalent measure of safety. Accordingly, a waiver of Section 238.215 is justified.

j. *Section 238.217 - Side Structure*

(1) FM Requirement and Purpose

Section 238.217 sets strength requirements for side posts and comer braces. This section also requires that outside sheathing of mild, open-hearth steel when used flat and without reinforcement in certain side frames be no less than 1/8-inch nominal thickness. When sheathing used for truss construction serves no load-carrying function, the minimum thickness is 40 percent of 1/8-inch nominal thickness. These specifications are intended to provide for additional structural protection, so that a car wiii derail before it collapses into the occupant compartments.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of these requirements because the SNJLRT vehicle is designed so that with a compression load of 40,000 pounds applied to the side wall at the side sill, and distributed along 8 feet, and a compression load of 10,000 pounds applied to the side wall at the belt rail, there will be no yielding or buckling of the carbody structure. The approach used in designing the SNJLRT aluminum carbody vehicle involved minimizing weight while providing maximum protection for passengers consistent with the service requirements. The floor level and design of the SNJLRT vehicle likely will prove superior to the typical low floor light rail vehicle in side impact collisions at grade crossings. The low floor portion of the car is 22” above top of rail, which is higher than a typical low floor vehicle. This affords better protection for the rail passenger should a highway vehicle strike it. The vehicle also has a well-lit interior and external indicator and marker lights and will therefore be more conspicuous than a regular commuter or freight train.

Additionally the relatively short train length (typically 102.5 feet (one car), with a maximum of 205 feet (two cars)) insures that the vehicle will not obstruct a grade crossing for an extended period. This, in conjunction with constant warning time crossing protection, will encourage observation of grade crossing warnings.

NJ Transit believes that although SNJLRT vehicle design elements set forth above may not conform to the specific requirements of the FRA regulation, they will provide, in conjunction with the other safety design features of the vehicles, an equivalent level of safety. Accordingly, a waiver of Section 238.217 is justified.

k. *Section 238.221 - Glazing*

Section 238.221 reiterates the safety glazing standards of 49 C.F.R. Part 223 and establishes standards for glazing securement components. The new requirements for glazing securement are designed to ensure that the glazing frame be capable of holding the glazing in place against all forces which it is required to resist under part 223 and forces created by air pressure differences caused when two trains pass at their authorized maximum speeds in opposite directions at the minimum track separation for two adjacent tracks. Glazing forced from the window opening is a potential hazard.

SNJLRT vehicles will meet the window securement requirements so no waiver is sought relative to that requirement. NJ Transit has already stated a basis for a waiver request for the remaining provisions as noted in discussion at Section III.D.2 above. On that basis, a waiver of Section 238.221(a) is justified.

1. ***Section 238.223 - Fuel Tanks***

(1) FRA Requirement and Purpose

This section provides for the structural requirements applicable to external and internal fuel tanks. External fuel tanks must comply with AAR recommended practice 506, Performance Requirements for Diesel Electric Locomotive Fuel Tanks, or an industry standard providing at least equivalent safety. Internal fuel tanks must be positioned to reduce the likelihood of accidental penetration from roadway debris or collision. The vent system and spill protection systems must be designed to prevent them from becoming a path for fuel loss for any tank orientation due to a locomotive overturning. The bulkheads and skin must have a minimum steel plate 3/8 of an inch thick with a 25,000 pound yield strength, or be made with a material with an equivalent strength. These requirements are designed to keep the fuel tank from being punctured and from being a conduit for fuel spillage if a locomotive tips over.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of these requirements because the SNJLRT vehicle will have an internal fuel tank and filler pipes that will be protected from the passenger compartment by fire barrier material, and which wili be properly insulated to prevent fire danger. The fuel tank will be constructed and located in a manner that will permit filling and draining from the outside of the vehicle only. Filler pipes will be equipped to complement filler hoses fitted with dry-break mechanical interlocks. The SNJLRT vehicle will be equipped with a safety cut-off device directly on the fuel line to the diesel engine which meets the requirements stated within the FRA locomotive safety standards, 49 C.F.R. $229.93, Internal Combustion Equipment, Safety Cut-off Device. The fuel tanks, engine and propulsion equipment are located in the drive unit positioned in the center of the articulated vehicle. The main fuel tank is located above the floor, and two additional fuel tanks are located within the side frame under the floor. The fuel tank was designed in accordance with UIC Standard 627 and will comply with the requirements of FHWA motor carrier safety standards for fuel systems, 49 C.F.R. $393.67. See Exhibit I. Refueling is done without pressure and there are level sensors to protect against overspilling.

The fuel tank design ensures that the passenger compartment is isolated from the fuel tanks and engine. The central placement of the drive unit provides significant protection for fuel storage and piping system. The fuel tanks are located above the floor line or between the side frame rails. The drive unit structure protects fuel storage and piping. During a derailment the carbody structure is more likely to come into contact with the rails than the fuel tanks. Therefore it is unnecessary to supply the heavy bulkhead ends required by the Association of American Railroads recommended practice 506. In addition, as part of the final design process, the SNJLRT Contractor will complete a full safety review of the fuel tanks and systems to demonstrate that the design is safe and meets appropriate sections of FHWA motor carrier fuel tank standards set forth at 49 C.F.R. Part 393. This design meets FRA safety objectives, but in a manner more appropriate to the SNJLRT vehicle and operation. Accordingly, a waiver of Section 238.223 is justified.

m. *Section 238.233 - Interior Fittings and Surfaces*

(1) FRA Requirement and Purpose

Section 238.233 requires each seat in a passenger car to be securely fastened to the carbody so as to withstand individually applied acceleration of 4g acting in the vertical and in the lateral direction on the deadweight of the seat or seats if a tandem unit. Seat attachments must have an ultimate strength capable of resisting a longitudinal inertial force of 8g acting on the mass of the seat plus the impact force of the mass of an unrestrained 95th percentile male occupant striking the seat from behind when the floor to which the seat is attached decelerates with a triangular crash pulse having a peak of 8g and a duration of 250 milliseconds. This section also requires overhead racks to provide longitudinal and lateral restraint for stowed articles and be attached to the car body with sufficient strength to resist loads due to a longitudinal force of 8g, a vertical force of 4g and a lateral force of 4g. Other interior fittings must meet the same strength requirements. In addition, to the extent possible, all interior fittings in the passenger car are to be recessed or flush-mounted and sharp edges and comers in the locomotive cab or passenger car will be either avoided or padded. Floor mounted seats provided for a crew member assigned to occupy the cab of a locomotive must be capable of withstanding the same load limits as required for overhead storage racks with the mass being that of the seat and a 95th-percentile male crew member. These requirements are designed to reduce the likelihood and severity of injury to train occupants caused by the dislodging of seats or other interior items or by occupants striking interior items in the event of an accident.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of these requirements because the seats and interior fittings of the vehicle have been designed for the SNJLRT operating environment. The vehicle is designed such that the passenger seat will consist of a cantilevered supporting structure, shell and cushion inserts for the seat and back. The vehicle seats are cantilevered from the side of the car, which permits placement of luggage beneath the seats. Aspects of this regulation are more appropriate to an intercity vehicle where luggage accompanies most passengers. This vehicle is used in local service where luggage is typically limited to small carry-on items such as purses, attache cases, etc. There is adequate space beneath the cantilevered seats to permit stowage of larger pieces of luggage, which limits the use of the overhead racks.

The vehicle interior will provide recess or flush-mounted fittings and readily accessible stanchions and grab rails for passenger safety and comfort. Stanchions and grab rails will be sized and located to provide optimum arrangement for all passengers. They will be of a color distinguishable by the partially sighted. Windscreens will be provided adjacent to each doorway, with at least the upper half transparent, and will incorporate a stanchion extending from the windscreen to the SNJLRT car ceiling. This vehicle also provides more floor space for passenger circulation than an intercity or commuter rail car due to its service characteristics.

It is also important to note that the proposed seat attachment strength requirements are a function of the proposed 800,000 pound compression strength requirement. Because the SNJLRT vehicles, however, have different compression strength values, it is not necessary for the SNJLRT car to meet the proposed 8g/4g force resistance requirements. In the SNJLRT vehicles, the provision of crashworthiness features will prevent acceleration in the passenger compartment from reaching such levels. Rather, the limit for collisions up to 15 mph is 2g. Moreover, the high emergency brake rate will mean that most collisions will be at a lower speed than would be the case with conventional commuter rail cars.

These design characteristics will provide the SNJLRT vehicles with an equivalent level of safety. Accordingly, a waiver of Section 238.233 is justified.

n. *Section 238.235 -Doors*

(1) FRA Requirement and Purpose

Section 238.235 provides that each passenger can must have a minimum of two exterior side doors with each door providing a minimum clear opening of 30 inches horizontally and 74 inches vertically. This section also provides for the availability of override devices enabling the opening of doors without power from both the inside and outside of the cars without the use of a tool or other implements.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver of these requirements because the SNJLRT vehicle is designed with an emergency release lever on the inside of each doorway and for at least one doorway per side on the outside of the vehicle. This will enable a closed and interlocked door to be lock-released without power supply. Activation of the emergency release levers will allow the door leaves to be manually moved. The interior emergency door release levers will be clearly marked and will be in a location accessible to all passengers, consistent with ADA requirements.

The SNJLRT vehicle will have doorways on both sides to permit egress time of an AW2 load in less than 120 seconds.[20] The passenger doorways are two-panel sliding plug type and flush with carbody in the closed position. They are opened and closed pneumatically and provide direct access from the platform to the car interior. There is no vestibule with secondary door access through a partition to the passenger compartment. The clear opening is 52.38 inches. The car has two doors per side in the low floor area. This door configuration permits evacuation of an AW2 (67 Tons – 180 Passengers) car from either side in 100 seconds. Also, with regard to

[20] Egress calculated assuming a flow-rate of two seconds per passenger flow lane, with a flow lane width of at least 24 inches and a minimum doorway clearance height of 76 inches.

emergency services access, all windows can be safely shattered to provide additional access/egress locations.[21]

The design of the door and windows provides an equivalent level of safety to the FRA specifications. Accordingly, a waiver of Section 238.235 is justified.

o. *Section 238.23 7 - Automated Monitoring*

(1) FRA Requirement and Purpose

Section 238.237 requires that controlling locomotives have working alerters. The alerter timing must be set by the operating railroad taking into consideration maximum train speed and signal system capabilities. Under this section, the working alerter must initiate a penalty brake application if the train operator does not respond to the alerter. If the alerter fails en route then a second qualified person will be stationed in the cab or the operator will be in constant communication with a second crewmember until the train reaches the next terminal. These requirements are intended to prevent a train collision or derailment due to the inattention or incapacity of the train operator, resulting is loss of control of the train.

(2) Request for Waiver and Safety Justification

NJ Transit requests a waiver from these requirements because the SNJLRT vehicle is equipped with its own controller and audible alerter features to provide an equivalent level of safety. If a vehicle operator fails to respond to an alerter approximately every 30 seconds, the vehicle goes into an immediate penalty brake application. A keyed control switch will be provided, which is interlocked such that only the master controller at the front end of the lead SNJLRT car of a consist is operable. The braking demand of the master controller and braking

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[21] Emergency access planning is also described in greater detail in Section III.D.6.

handle always has priority over the motoring demand. The drive control unit controls and supervises the protective functions of the propulsion converter.

In addition to the master controller, redundant safety systems are provided. For example, the vehicle is also controlled by enforce-stop devices which initiate a brake application if the vehicle fails to respond to signal commands. Also, an emergency stop push-button will be provided such that, when pushed, it will activate the emergency brakes. It will be possible to activate the emergency stop push-button from any console in a consist. Finally, the SNJLRT service route involves frequent station stops in signaled territory under control of a dispatcher. Violation of a signal aspect will result in a penalty brake application. Accordingly, a waiver of Section 238.237 is justified.

p. *Sections 238.301-238.319-Inspection, Testing and Maintenance*

Subpart D of Part 238, Sections 238.301 through 238.319, contains requirements pertaining to the inspection, testing and maintenance of the passenger equipment and systems required for Tier I passenger equipment. These requirements are designed to ensure that passenger rail operations are conducted only on vehicles whose components and systems are in good working order, thereby reducing both the chances of a equipment-related accident and the severity of damage or injury in the case of an accident.

NJ Transit anticipates being in compliance with the requirements of Subpart D. However, NJ Transit requests a waiver of any requirements that correlate to the Subpart B or C standards from which NJ Transit has sought waivers to depart. SNJLRT equipment will be subject to a detailed program of inspection, testing and maintenance, as required by the NJDOT SSPS and the SNJLRT SSPP. Specifically, Section 5.1.5. of the NJDOT SSPS requires the

SSPP to provide for periodic and as needed maintenance inspection and testing of equipment and facilities, as well as training and certification of employees in safety-sensitive positions. See Exhibit G. The SNJLRT SSPP will address these issues in detail, setting forth specific inspection maintenance and testing schedules and protocols for all major equipment, components and systems. Compliance with the SSPP requirements will be monitored through a periodic audit and reporting program. See Section 14 of the NJDOT SSPS, Exhibit G.

6. Part 239

a. FRA Requirement and Purpose

Part 239 contains standards for the preparation, adoption, and implementation of emergency preparedness plans by railroads connected with the operation of passenger trains. It is intended that by providing sufficient emergency egress capability and information to passengers and by having emergency preparedness plans calling for coordination with local emergency response officials, the risk of death or injury to passengers, employees and others in the case of accidents or other incidents, will be lessened. This rule was adopted as a result of several serious crashes involving commuter trains.

b. Request for Waiver and Safety Justification

NJ Transit requests a waiver of this requirement because the SNJLRT system will be operated in accordance with the emergency preparedness specifications of the SNJLRT SSPP, under the oversight of the NJDOT's State Safety Oversight Program. The SSPP sets forth procedures and requirements dealing with emergency situations tailored to the SNJLRT system, but which also draw on the experience of emergency preparedness standards from other rail transit systems whose operations and equipment more closely resemble the SNJLRT system than

FRA regulated commuter rail systems. Section 5.1.4.1 of the NJDOT SSPS requires NJ Transit to adopt an emergency response plan and procedures which must include a means to communicate and coordinate with external emergency response agencies, and provide for emergency simulations and drills, and training. See Exhibit G. Section 9 of the SSPS, Security, requires the SSPP to contain Emergency Operating Procedures to deal with a variety of emergency situations, including accidents and natural disasters as well as sabotage or other criminal activities. See Exhibit G. The SNJLRT SSPP will contain a detailed emergency response plan which will provide for contingency planning for passenger evacuation and crowd control coordination, training and simulation drilling with outside emergency response providers. The emergency response plan will also specify required emergency equipment.

In addition to emergency response planning required by Sections 5 and 9 of the SSPS, the SSPS requires NJ Transit to engage in a process by which hazards occurring in operations, maintenance and engineering are identified and categorized according to severity and likelihood. Resolutions to reduce hazards to the lowest level practical must then be considered. See SSPS, Section 7, Exhibit G. This process will help the SNJLRT contractor to develop the emergency response plan, including the design, in advance, of processes for handling exceptions to established procedures where situations require them. A hazard resolution matrix will be included in the SSPP.

In addition, the Safety Committee will address emergency preparedness issues and provide coordination between NJ Transit, the SNJLRT Contractor, Conrail and local emergency response agencies. The NJDOT, as part of its oversight activities will be responsible for investigation of accidents and other emergency situations.

These emergency preparedness standards will provide a level of safety equivalent to the FRA requirements in a manner more appropriate to the SNJLRT operating environment. Accordingly, a waiver of the Part 239 requirements is justified.

IV. CONCLUSION

The SNJLRT system has been designed with safety as its number one priority. This, along with NJDOT state safety oversight and complete temporal separation of SNJLRT and Conrail operations will meet the needs of railroad safety and the public interest. For the foregoing reasons, NJ Transit respectfully requests that FRA approve the proposed shared use and grant the waiver requests set forth above.

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ATTORNEYS FOR NEW JERSEY TRANSIT CORPORATION

Dated: July 13, 1999

NJT Petition for Approval of Shared Use and Waiver of FRA Regulations

Appendix - Exhibits

Exhibit List

Exhibit A - SNJLRT Map

Exhibit B - SNJLRT Track Chart

Exhibit C - NJ Transit/Conrail Letter of Intent

Exhibit D - SNJLRT Bid Document Regarding System Safety Program Plan Requirements

Exhibit E - SNJLRT Vehicle Specifications

Exhibit F - FTA Letter to NJDOT Confirming Compliance with 49 CFR 659

Exhibit G - NJDOT System Safety Program Standard

Exhibit H - ANSI 226.1, Table 1, Item 1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways

Exhibit I - UIC Standard 627

Exhibit A

SNJLRT Map

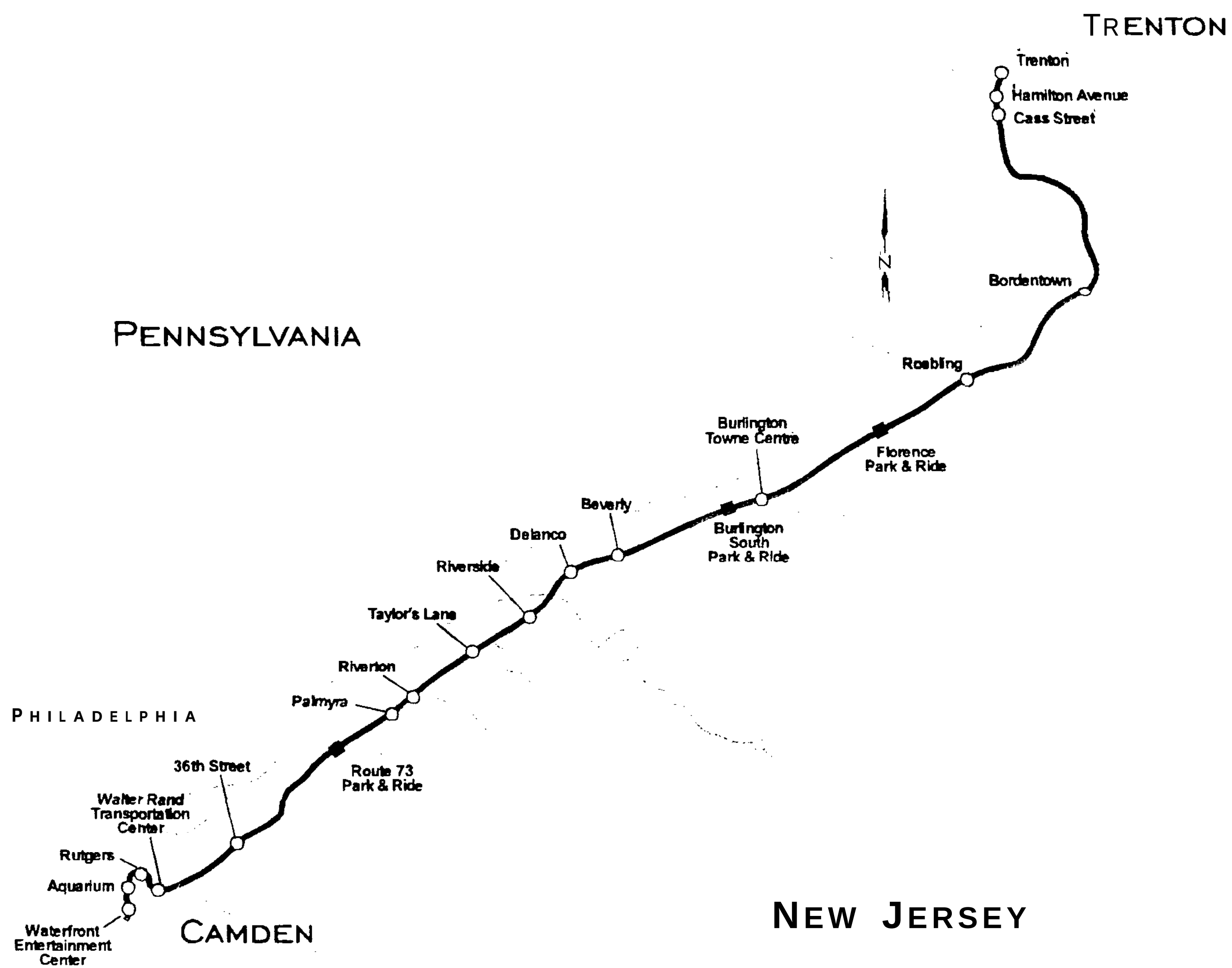

TRENTON
Trenton
Hamilton Avenue
Cass Street
N
Bordentown
PENNSYLVANIA
Roebling
Burlington Towne Centre
Florence Park & Ride
Beverly
Burlington South Park & Ride
Delanco
Riverside
Taylor's Lane
Riverton
Palmyra
PHILADELPHIA
36th Street
Route 73 Park & Ride
Walter Rand Transportation Center
Rutgers
Aquarium
Waterfront Entertainment Center
CAMDEN
NEW JERSEY

Exhibit B

Track Chart

AVAILABILITY OF NON-SCANNABLE ITEMS

FRA 99-6137-1

Document Number

Old Docket Number, If any

Exhibit B SNJLRT
Track Chart

Name / Description of Item(s) non-scannable

MAY BE VIEWED IN /Room

1120 Vermont Avenue, N.W. - 7th Floor
Wash. D.C.

Agency/Office Name / Room Number/Contact Person (if any)

during the hours of 9-5 p.m.

(word*.0:' R: ascanitm)

Exhibit C

NJ Transit/Conrail Letter of Intent

LETTER OF INTENT

This non-binding Letter of Intent of June 1, 1999 between Consolidated Rail Corporation ("Conrail") and the New Jersey Transit Corporation (NJ TRANSIT) is to outline the significant terms and conditions of certain agreements to be negotiated between Conrail and NJ TRANSIT regarding the introduction of the Southern New Jersey Light Rail System (the "Light Rail Service") over the Bordentown Secondary Track (between approximately MP 1.07 in Camden County to approximately MP 33.9, not including any Conrail yard facilities and certain connecting and industrial tracks which will not be a part of any conveyance) between Camden and Trenton, New Jersey (the "BST"), which is owned and operated by Conrail.

1. Conrail and NJ TRANSIT recognize and agree that the guiding principles set forth in this Letter of Intent are intended to facilitate the introduction of Light Rail Service on the BST within the existing Conrail freight rail corridor and, further, are intended to establish the processes that will govern the parties as they seek to negotiate agreements in furtherance of this project. The parties recognize that the Light Rail Service on the BST, as contemplated, represents a unique project in the history of the Conrail/NJ TRANSIT relationship. Accordingly, given the uniqueness of the project contemplated and the singular nature of this transaction, the parties recognize and agree that the guiding principles described herein and the transactions contemplated hereunder do not in any way establish precedent for other light rail projects that may be considered in New Jersey or elsewhere on the Conrail, CSX or Norfolk Southern rail networks.

2. Conrail will convey to NJ TRANSIT all of Conrail's right, title and interest in and to (1) the real estate which constitutes its BST, together with all buildings, improvements, fixtures and appurtenances thereto, including rail and other track materials, ties, wires, pipes, conduits, electrical or mechanical signal devices (except for the rights to be specifically reserved by Conrail in the purchase and sale agreement, generally as provided at Section 3 of this Letter of Intent); and (2) all leases, easements, licenses, permits, privileges and sidetrack, trackage rights and other agreements pertaining to the premises (except as will be specifically reserved by Conrail in the purchase and sale agreement). In consideration for this conveyance of property, NJ TRANSIT will pay to Conrail the sum of $67.5 million, which sum additionally reflects the value to NJ TRANSIT of various benefits that will be conferred on NJ TRANSIT by this transaction. These benefits include, but are not limited to: (1) the ability to provide uninterrupted light rail passenger service, seven days a week, during favorable day-time operating hours, to residents of the City of Camden, the City of Trenton and the riverside communities along the BST; (2) the ability to perform right of way maintenance unimpeded by freight services, during a twenty-four hour window; (3) Conrail's improvement of its Delair Bridge, which is used by NJ TRANSIT for its Atlantic City railroad line; (4) Conrail's improvement of its rail yards that will ensure compatibility of freight and Light Rail Service; and (5) the avoidance of protracted, time-consuming and costly condemnation proceedings. Conveyance of the BST to NJ TRANSIT is

being made under threat of condemnation. The parties expect that construction of the light rail facilities will commence after NJ TRANSIT's purchase of the BST.

3. Conrail will retain an exclusive, perpetual, transferable and irrevocable easement in the BST respecting the operation of rail freight service and present and future access to shippers, consistent with operations as generally provided at Section 5. Accordingly, Conrail will continue to provide common carrier and contract freight service over the BST, and will retain the unrestricted right to assign or grant trackage rights or other operating rights to third parties to conduct freight operations and provide rail freight service on the BST. Further, Conrail will retain for its exclusive benefit all rights existing as of the closing date in any agreements respecting fiber optic and any other communication systems over, under through and along the entire BST. Further, Conrail and NJ TRANSIT will work together to maximize future income opportunities in the BST, to be shared equally between the parties, and upon such other terms that will be negotiated in the agreement of purchase and sale, provided such agreements do not unreasonably interfere with NJ TRANSIT's or Conrail's use, operation or occupancy of the BST. All required relocations or modifications of existing cables, lines, facilities or equipment to accommodate the construction of NJ TRANSIT's Light Rail Service, shall not be at Conrail's cost and expense; otherwise any such relocations not required to accommodate the construction of NJ TRANSIT's Light Rail Service shall not be at NJ TRANSIT's expense.

4. The parties contemplate that all operations on the BST, including Light Rail Service and freight rail operations conducted by Conrail or its successors or assigns, will be conducted in accordance with a separate operating and maintenance agreement. Subject to the operating agreement, it is expected that NJ TRANSIT will control dispatch of the BST at all times and provide liquidated damages to Conrail for any neglect or abuse of dispatch which unreasonably interferes with or constrains Conrail's ability to serve its customers. The parties recognize that NJ TRANSIT shall provide or arrange for the providing of all routine and non-routine maintenance and repair on the BST at its sole cost and expense. NJ TRANSIT's track maintenance, as well as signal, switch and track inspections will be performed during NJ TRANSIT's operation window or during the day Conrail does not operate freight service and otherwise so as not to interfere with Conrail's ability to service its customers in the Freight Operating Window, as defined at section 5. Conrail expects to reserve the right to conduct maintenance, at NJ TRANSIT's expense, if NJ TRANSIT does not maintain the freight track to Class II standards or the conduct of NJ TRANSIT's maintenance unreasonably interferes with Conrail's ability to conduct freight operations. Conrail will compensate NJ TRANSIT for maintenance and operating expenses in an amount consistent with other agreements between the parties.

5. Freight operations and light rail service will occur in exclusive windows until such time as the Federal Railroad Administration (FRA) will permit concurrent or same-time parallel track operation of light rail passenger and freight service on the BST. Prior to that, NJ TRANSIT will have unlimited access and use of the BST to operate a Light Rail System on the BST behveen the hours of 0600 and 2200, seven (7) days per week (the "Passenger Operating Window"). Conrail will not be permitted access to or use of the BST during the Passenger Operating Window, except in the event of emergencies, as provided at Section S, or upon prior agreement with NJ TRANSIT. Conrail shall have unlimited access and use of the BST behveen

the hours of 2200 and 0600, six (6) days per week (the "Freight Operating Window"). NJ TRANSIT will not be permitted access to or use of the BST during the Freight Operating Window except upon prior agreement with Conrail. In any event, all operations must be conducted in accordance with any requirements of the STB which it may impose in any approval of the operation, and any requirements of FRA.

6. The parties recognize that Light Rail Service in the BST may create operational impediments which may impact Conrail's ability to serve its customers unless certain improvements and upgrades occur on the BST. NJ TRANSIT expressly recognizes and agrees that it must satisfy certain operating requirements, as provided in this Letter of Intent, so that Conrail can continue freight service along the BST as contemplated by the parties. The parties agree that a time-separated freight operations plan for the BST using the March 1999 Operating Plan as a basis, with the revised track infrastructure as presented to Conrail on May 6, 1999, will mitigate many substantial impacts that the Light Rail Service may have on Conrail's ability to serve its customers so long as the additional modifications set forth below, to be effected at NJ TRANSIT's expense (except as provided herein), are included:

a. NJ TRANSIT will add a crossover at or near MP 16 to facilitate the meeting and "swapping" of trains.

b. Conrail must review and approve and may modify, if necessary, the final layout of the tracks in the new Burlington Yard, which NJ TRANSIT will build, to ensure that adequate clearance is preserved off of the main tracks so Conrail can operate in the Burlington Yard 24 hours a day. NJ TRANSIT and Conrail agree to work cooperatively to review any such plans for the possible movement of the yard facilities. Conrail may modify the May 1999 Track Plan for the Burlington Yard to ensure the proposed freight operation in the Yard does not interfere with the Light Rail Service. Any such modifications must be within the current legal boundaries of the Yard and will be constructed by NJ TRANSIT at Conrail's expense.

c. NJ TRANSIT will convert the freight-only track which stub-ends at MP 22.4 to a turnout from the main track.

d. If requested, NJ TRANSIT will construct, at Conrail's expense, a proposed siding at Robinsville to extend the current siding an additional 4,500 feet, for a total length of at least 6,500 feet.

e. NJ TRANSIT must arrange or otherwise provide for sufficient clearance at "HATCH", behveen the Conrail move to the Delair Bridge and the light rail route to Pavonia, to ensure that light rail operations will not impact Conrail 24-hour operations. NJ TRANSIT agrees to bear the cost of any additional capital improvements that may be required to accomplish such clearance. Conrail agrees to cooperate with NJ TRANSIT if modifications to Conrail's infrastructure are required.

f. NJ TRANSIT must ensure clearance around Pavonia Yard so that light rail operations have no impact on Conrail's 24-hour operations at this facility. NJ TRANSIT agrees to bear the cost of any additional capital improvements that may be required to accomplish such clearance. Conrail agrees to cooperate with NJ TRANSIT if modifications to Conrail's infrastructure are required.

The parties recognize that Conrail will have the right to review and approve and modify as necessary the final layout and design of the Light Rail System within the BST. Any additional changes resulting from Conrail's modification to the May 6, 1999 Track Plan will be performed at Conrail's sole cost and expense. Any additional modifications or other changes to the infrastructure demanded or otherwise requested by FRA for time-separated operations, will be performed at NJ TRANSIT's sole cost and expense.

Should the STB require mitigation of any impacts to Conrail customers resulting from the March 1999 operating plan, Conrail and NJ TRANSIT agree to work in good faith to develop a solution acceptable to the STB, looking first to operating adjustments (including the addition of trains or crews) which shall be at the sole cost and expense of Conrail. If the STB does not agree that the operating adjustments made by Conrail have satisfactorily addressed the impacts, additional changes or modifications may be made to the May 6 Track Plan, which will be performed at the sole cost and expense of NJ TRANSIT.

7. It is understood that Conrail must have 24-hour use of the Burlington Yard and 24-hour access to, from and through Pavonia Yard from and to the Delair Bridge at Hatch. Subject to Section 6(b), Conrail agrees to utilize Burlington Yard in a manner that will not impact light rail operations on the BST. Conrail will set up and break down freight trains in its yard facilities at either end of the Freight Operating Window during the Passenger Operating Window. Except as provided at Section 6(b), NJ TRANSIT agrees to provide, at its sole expense, any capital improvements that may be required to satisfy FRA that Conrail's yard operations do not constitute the commingling of freight and light rail operations on the BST. Conrail will use diligent efforts to conduct such activities in Conrail's yards in a manner which will not interfere with Light Rail Service.

8. Conrail will bear the cost of any additional equipment it may need to facilitate time-separated operations on the BST (but not the cost of capital improvements discussed elsewhere in this Letter), and expects to bear the cost of maintenance and rehabilitation for its Delair Bridge (the "Bridge"). Conrail expects to commence such rehabilitation of the Bridge within five years of execution of this Letter of Intent. NJ TRANSIT recognizes that the Bridge is vital to Conrail's operation. In the event of a Bridge failure or Conrail's inability to use the Bridge due to circumstances beyond the control of Conrail, then Conrail will require use of the BST for overhead freight service until service over the Bridge can be restored. For emergency detours, Conrail agrees to provide NJ TRANSIT with as much notice as possible under the circumstances should the sudden failure of the Bridge require Conrail to use the BST. In these circumstances, Conrail agrees to attempt to restrict its use of the BST to nighttime hours, if possible, or during a window during daytime hours, all as agreed between the parties working in good faith. For other emergency detours required due to infrastructure failures or derailments which create the inability to use the freight rail facilities between the Bridge and Pavonia Yard, Conrail may require temporary use of the BST. In these circumstances, Conrail agrees to attempt

to restrict its use of the BST to nighttime hours, if possible, or during a window during daytime hours, all as agreed between the parties working in good faith.

9. The operating agreement for the BST will include contractual indemnification provisions not inconsistent with the NJ TRANSIT/Conrail 1984 Trackage Rights Agreement. NJ TRANSIT will pay Conrail $1.2 million per year in consideration of, and for reimbursement of expenses related to insurance or self-insurance of, Conrail's assumption of the liability risk imposed under any such operating agreement. The parties agree to reevaluate NJ TRANSIT's obligation to pay the $1.2 million per year in the event of any change of circumstances which has a significant impact on the liability of the parties to this Letter of Intent.

Further, NJ TRANSIT agrees to maintain in full force and effect NJ TRANSIT's current insurance program which secures its current contractual indemnification of Conrail.

During construction of the Light Rail System, NJ TRANSIT agrees to provide adequate railroad protective insurance, builder's risk and such other policies of insurance in accordance with NJ TRANSIT's OCIP insurance program for the project. NJ TRANSIT agrees to indemnify and hold Conrail harmless for all losses, claims, remediations and all other damages if NJ TRANSIT causes or contributes to the discharge of hazardous substances. NJ TRANSIT will dispose of environmental contamination that may be disturbed as a result of the construction of the Light Rail System, as required by DEP, in accordance with the remedial action work plan approved by DEP for the project. NJ TRANSIT will not be responsible for remediation of any conditions on the BST currently subject to any ongoing responsibility of Conrail, including its remediation of Pavonia Yard. The parties expect to further allocate responsibility for environmental conditions on the BST through the purchase and sale agreement.

10. NJ TRANSIT recognizes Conrail's desire that the State of New Jersey diligently pursue the enactment of legislation that (1) permits indemnification of rail freight operators by rail passenger operators, including operators of light rail systems, including indemnification for punitive damages, (2) requires rail passenger operators to maintain a certain level of liability insurance coverage; (3) limits the liability of rail freight and rail passenger operators to the amounts of the required insurance. coverage; (4) includes in the cap awards of punitive or exemplary damages; and (5) provides that rail passenger operators, including state agencies, may execute agreements with freight railroads respecting commuter or light rail service in which the passenger operator promises to secure and maintain liability insurance covering the liability of the passenger operator and the freight railroad for property damage, personal injury, bodily injury or death arising out of the rail passenger service. Given the benefits to NJ TRANSIT as well, NJ TRANSIT agrees to make good faith efforts to immediately and diligently pursue legislation that caps the tort liability exposure of freight and passenger railroads as well as light rail operations. NJ TRANSIT also agrees to continue to work with Conrail and other freight railroads in pursuing additional legislation on a schedule to be mutually agreed upon to address all of the specific issues identified above. In no case shall the status of the legislative effort affect the status of the transactions contemplated under this Letter of Intent or the commencement, construction, or operation of the Light Rail System on the BST.

11. As proposed by the FRA, NJ TRANSIT will diligently work with FRA to develop proven, cost effective and available technologies that will allow safe commingling or simultaneous parallel-track freight and passenger operations on the BST. NJ TRANSIT will immediately implement such technologies on the BST once they have been developed, tested and proven reliable, wherever such concurrent, parallel-track operations may first receive FRA approval and-are determined to be sufficiently comparable to light rail service on the BST. NJ TRANSIT recognizes and agrees to bear the entire cost of all capital improvements or other upgrades needed on the BST that will facilitate the safe commingling or simultaneous freight and passenger operations on the BST. At such time, Conrail will be granted the ability to operate on the BST on a 24 hr/day basis. Prior to the introduction of simultaneous freight and passenger service, NJ TRANSIT agrees to bear the cost of all capital improvements to upgrade the tracks consistent with the March 1999 Operating Plan, except as the parties may otherwise agree.

12. NJ TRANSIT and Conrail pledge to work in good faith to complete all negotiations necessary to allow construction of the Light Rail System to proceed on schedule and to close the transfer of title on or before September 1, 1999. NJ TRANSIT may postpone such closing and thereafter close the transfer of title and pay Conrail the full agreed-upon compensation on or before December 15, 1999. In the event closing occurs prior to December 15, 1999, NJ TRANSIT reserves the right through and until December 15, 1999, to rescind the purchase and sale agreement for any reason whatsoever and terminate all further agreements contemplated by this Letter of Intent, at which time Conrail agrees to promptly return all compensation paid by NJ TRANSIT. Following such rescission, NJ TRANSIT shall restore the BST to a condition acceptable to Conrail, in Conrail's sole discretion. NJ TRANSIT's duties and obligations under Section 9 of this Letter of Intent respecting the discharge and disposal of environmental contamination shall survive any such rescission hereunder.

13. NJ TRANSIT agrees to assume the responsibility, if required, to obtain at NJ TRANSIT's sole expense, all required governmental approvals, including any necessary approvals from the Surface Transportation Board. Conrail reserves the right to review and approve any such petitions and agrees to cooperate with NJ TRANSIT in all respects to obtain such approvals.

14. The parties understand that this letter creates no binding obligation. Over the next 90 days, the parties expect to negotiate subsequent enabling agreements such as a purchase and sale agreement, construction agreements, an operating and maintenance agreement, and other such agreements as may be necessary for the light rail transit system NJ TRANSIT intends to construct and operate. There are no binding commitments of any kind until such final agreements are complete. Either party may terminate this Letter of Intent for any reason upon termination of the 90 day period. In the event of its termination for any reason, neither NJ TRANSIT nor Conrail will have any liability or obligation to the other as a result of such termination. Specifically, Conrail reserves the right to terminate this Letter of Intent in the event of any action brought by any party that seeks to enjoin further actions contemplated hereunder or seeks damages against Conrail due to the sale of the BST and the introduction of light rail service. The principles contained herein will not be binding until Conrail and NJ TRANSIT execute agreements containing these terms which have been approved by NJ TRANSIT's Board of Directors and Conrail's Executive Committee. Pursuant to NJSA 27:25-17 and the constitutional prohibition wherein an instrumentality of the

State of New Jersey cannot unequivocally guarantee a debt or pledge the credit to the State of New Jersey, all agreements or obligations of NJ TRANSIT established by this Letter of Intent, if any, are to be interpreted as if the words "subject to the availability of funds" were set forth therein in their entirety.

CONSOLIDATED RAIL CORPORATION

By:____________________________

NEW JERSEY TRANSIT CORPORATION

By:____________________________

This Letter of Intent has been approved as to form only.
Paul H. Zoubek
Acting Attorney General of New Jersey

By: Rebecca Fields
Deputy Attorney General

armistead\maa\c&a\conrail & NJT(FINAL).letter of intent

Exhibit D

SNJLRT Bid Document Regarding System Safety Program Plan Requirements

NJ TRANSIT SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

NJ TRANSIT
SYSTEM SAFETY PROGRAM PLAN
VOLUME H

DMJM • BA&H

Daniel, Mann, Johnson, & Mendenhall - Booz·Allen & Hamilton

SUBCONSULTANTS

[illegible] Testing [illegible] of New Jersey • [illegible] Environmental Laboratories • [illegible] Corp. • R.L. [illegible] • Boswell [illegible] Environmental • Connor Environmental Services and Engineering • Contract Compliance, Inc. • Delaware Valley Regional Planning • Lynn Drobbin & Associates • El Taller Colaborativo PC • Finger & Moy Architects • Garg Consulting Services • Groundwater Environmental Services • Katherine Hackl • KS Engineering • Hill International Inc. • Hopkins & Sutter • Hunter Research Inc. • Jersey Boring & Drilling • [illegible] Construction Management Systems • Marilyn Keating • KM Chng Environmental Inc. • Matrix Environmental & Geotechnical Services • John Milligan CPA • MKE Centennial • Mundle & Associates • Hiroshi Murata • Nossaman Guthner Knox & Elliott • Jeffrey A. Parker & Assoc. • [illegible] Enterprises • Professional Assoc[illegible] Consulting • Russell Corrosion Consultants • Transportation [illegible]

Revision Record

Date Issued	Submittal Name	Pages Affected
January 8, 1998	Invitation For Bid	First Issue: Books I - X & Volumes A - 0
February 20, 1998	Addendum #1	Pg. A - 7 - Sect. 2.1.6 - Para. 1 Pg. 12 of 43 in PHL
March 17, 1996	Addendum #3	Pg. 7 - (Change page number from A-7) Pg. A-7 (Reissue - no change) Pg. 12 of 43 in PHL

Revision Record

Date Issued	Submittal Name	Pages Affected
January 8, 1998	Invitation For Bid	First Issue: Books I - X 8 Volumes A - 0
February 20, 1998	Addendum #1	Pg. A - 7 - Sect. 2.1.6 - Para. 1 Pg. 12 of 43 in PHL

NJ TRANSIT

Southern New Jersey Light Rail Transit System

VOLUME H

SYSTEM SAFETY PROGRAM PLAN

Invitation For Bid

DMJM . BA&H

Daniel, Mann, Johnson, & Mendenhall - Booz·Allen & Hamilton

January 8, 1998
Newark, New Jersey

Revision Record

Date Issued	Submittal Name	Pages Affected
January 8, 1998	Invitation For Bid	First Issue: Books I - X & Volumes A - 0

TABLE OF CONTENTS

LIST OF EXHIBITS

1 INTRODUCTION

The System Safety Program Plan (SSPP) documents the safety program for the Southern New Jersey Light Rail Transit System (SNJLRTS) to assure it is designed, constructed and operated safely and securely. The SSPP identifies, describes, schedules and assigns responsibilities for safety and security tasks, which are to be accomplished throughout all phases of the SNJLRTS project.

The SSPP includes such tasks as:

- Identifying Design Codes, Regulations, Guidelines
- Conducting Safety Audits
- Developing Rules and Procedures
- Establishing Certification Programs
- Developing Training Programs
- Establishing a Safety Committee.

The SNJLRTS SSPP has been prepared in accordance with the New Jersev State Safetv Oversioht Program for Fixed Guidewav Svstems, System Safetv Program Standards. In addition, the American Public Transit Association (APTA) Manual for the Development of Rail Transit Svstem Safetv Proqram Plans, August 20, 1991, was used for guidance in preparing this Plan.

1.1 GOALS

The goal of the SSPP is to define activities, management controls and monitoring processes to ensure that:

- Safety and security considerations, compatible with other system requirements, are incorporated into the design of SNJLRTS facilities and equipment in order to minimize the potential for accidents or criminal activity during revenue operations

- Hazards associated with the SNJLRTS system are identified and then eliminated or minimized to obtain an acceptable level of safety and security

- The safety philosophy of the SNJLRTS system emphasizes preventive measures over corrective measures to eliminate unsafe conditions

- Safety information and lessons learned at newer transit properties (which have characteristics similar to SNJLRTS) are analyzed and used to support the SNJLRTS system safety and security program

- Customers, employees, and SNJLRTS property are protected from hazards or unsafe conditions.

1.2 SCOPE

This Plan encompasses the administrative and technical safety and security related activities to be performed during all phases of the SNJLRTS Project. The Plan addresses requirements directed at designing, constructing, testing and operating the SNJLRTS system in an effort to provide a safe and secure system.

During all phases of design, the emphasis of the safety and security program will be on eliminating, minimizing and controlling hazards through design analysis, review, and equipment selection. During the construction phase, the emphasis will shift to assuring the system meets the safety requirements identified in the final design documents, and preparing for testing and operations by developing and providing input to safety-related rules, procedures and training programs.

1.3 AUTHORITY

The Public Transportation Act of 1979 (Laws of 1979, Chapter 150) created the New Jersey Transit Corporation (also known as NJT) to operate and maintain rail and bus service in the State. NJT is also authorized to issue contracts for design, construction and/or procurement services for new equipment and facilities, as required to meet the transportation needs of the State of New Jersey.

The authority of NJT to establish its own safety rules, procedures, and regulations is largely limited to the development of operating rules and instructions. The New Jersey Department of Transportation (NJDOT), Division of Motor Vehicles (DMV), is identified as the state oversight agency to review and recommend changes to such rules and instructions and conduct performance audits of SNJLRTS Operations. NJDOT is responsible for safety oversight of fixed guideway systems not regulated by the Federal Railroad Administration (FRA).

Operations over portions of the SNJLRTS mainline will be shared with a freight rail operator. Operations will be time separated from freight to prevent assertion of jurisdiction over SNJLRTS by the FRA. The section of the SNJLRTS line owned by the rail freight operator will be used by SNJLRTS under an agreement between the DBOM Contractor (furthermore referred to as the Contractor) and the rail freight operator. Freight operations will be primarily running at night, when the SNJLRTS passenger service is not scheduled to operate.

A formal on-site review and audit of SNJLRTS will be performed by NJDOT once every three years to evaluate the implementation of the SSPP. In addition, NJT is required to perform, document and maintain records of annual internal audits. A formal report summarizing these internal audits is required for submittal to NJDOT.

Working jointly in partnership with local police agencies, the New Jersey Transit Police will provide law enforcement for SNJLRTS, including fare enforcement. The Contractor will provide security for all system assets of SNJLRTS. The security related responsibilities, tasks and schedules are contained in Appendix A, System Security Plan.

1.4 UPDATE PROCEDURES

Once selected, the DBOM Contractor will be required to update this SSPP to reflect their approach to final design, construction and operation of SNJLRTS. Anticipated changes will:

- Modify existing task descriptions and activities specific to final design, construction and revenue operations
- Identify new tasks which may be required as the system is designed
- Describe their project team organization including the identification of individuals who are responsible for the various safety tasks.

Further updates to the SSPP may be required to reflect changes in the program. Prior to commencing operations, the Contractor's SSPP must be submitted to NJT and NJDOT for review and approval. It will be the responsibility of the Contractor to incorporate any comments received and gain full approval by NJT and NJDOT prior to commencing operations.

1.5 GLOSSARY OF TERMS

The following presents a glossary of acronyms and terms used in this SSPP:

TERM	DESCRIPTION
AAR	Association of American Railroads
ANSI	American National Standards Institute
APTA	American Public Transit Association
AREA	American Railway Engineering Association
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
DBOM	Design: Build, Operate and Maintain
EPA	Environmental Protection Agency
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GDAC	General Design Assistance Consultant
Hazardous Condition	A condition that may endanger human life or property. It includes unacceptable hazardous conditions. (Source: NJDOT)
IEEE	Institute of Electrical and Electronic Engineers
Incident	Any unforeseen event or occurrence which presents a hazardous condition but does not necessarily result in injury or property damage. (Source: NJDOT)
Injury	A passenger, employee or other person requires transport to a medical facility by ambulance or police vehicle for medical treatment. (Source: NJDOT)
NJT	New Jersey Transit, an agency under the authority of the State of New Jersey and responsible for the bidding and agency oversight of the SNJLRTS system
NTSB	National Transportation Safety Board, which has the responsibility and authority for conducting accident investigations and making recommendations to the Federal Government
Occupational Illness	See NJ Public Employees Occupational Safety and Health Act (NJSA 34:6A-25 et Seq.), Safety and Health Standards for Public Employees (NJAC 12: 100) and OSHA definition.
System Safety	The application of operating, technical, and management safety techniques to the system to reduce hazards to the lowest level possible within system resources
Unacceptable Hazardous Condition	A hazardous condition determined to be an unacceptable based on hazard risk categories defined for SNJLRTS in this SSPP.

1.6 APPLICABLE DOCUMENTS

The following list of documents were either used in preparation of this Plan or are references and provide related information:

1. American Public Transit Association, Rail Safety Review Board, <u>Manual for the Development of Rail Transit System Safety Program Plans,</u> August 20, 1991.

2. National Fire Protection Agency, Standard for Fixed Guidewav Transit Systems, Standard 130, August 11, 1995.

3. New Jersey State Oversight Program for Fixed Guideway Systems, New Jersey Administrative Code, Svstem Safety Program Standards (Draft), November 11, 1996.

4. Department of Defense, Svstem Safety Proqram Requirements, MIL-STD-882C.

2 SYSTEM DESCRIPTION

This following system description is based on information contained in Book III, System Requirements.

2.1 SYSTEM OVERVIEW

SNJLRTS is a proposed diesel light rail transit system consisting of two corridors, one between Trenton and Camden (i.e., the Initial Operating Corridor or IOC) and another between Camden and Glassboro. This document applies to the IOC only; a map of which is provided in Exhibit 2-l.

2.1 .1 Alignment

The IOC is approximately 34 miles in length and will serve 20 stations stops. The alignment includes 26 miles of existing railroad right-of-way and bridges. Two miles of the alignment require the development of a new track to extend SNJLRTS service into the City of Camden.

SNJLRTS travels from Camden along and across River Road, northeast through the countryside of the Delaware River, under I-295, through Bordentown and north into downtown Trenton, terminating in the Trenton Northeast Corridor station.

The SNJLRTS rail system provides direct service to such major activity centers as the Waterfront Entertainment Center, New Jersey State Aquarium, Walter Rand Transportation Center, the Delaware River waterfront towns and the Northeast Corridor Rail Station in Trenton.

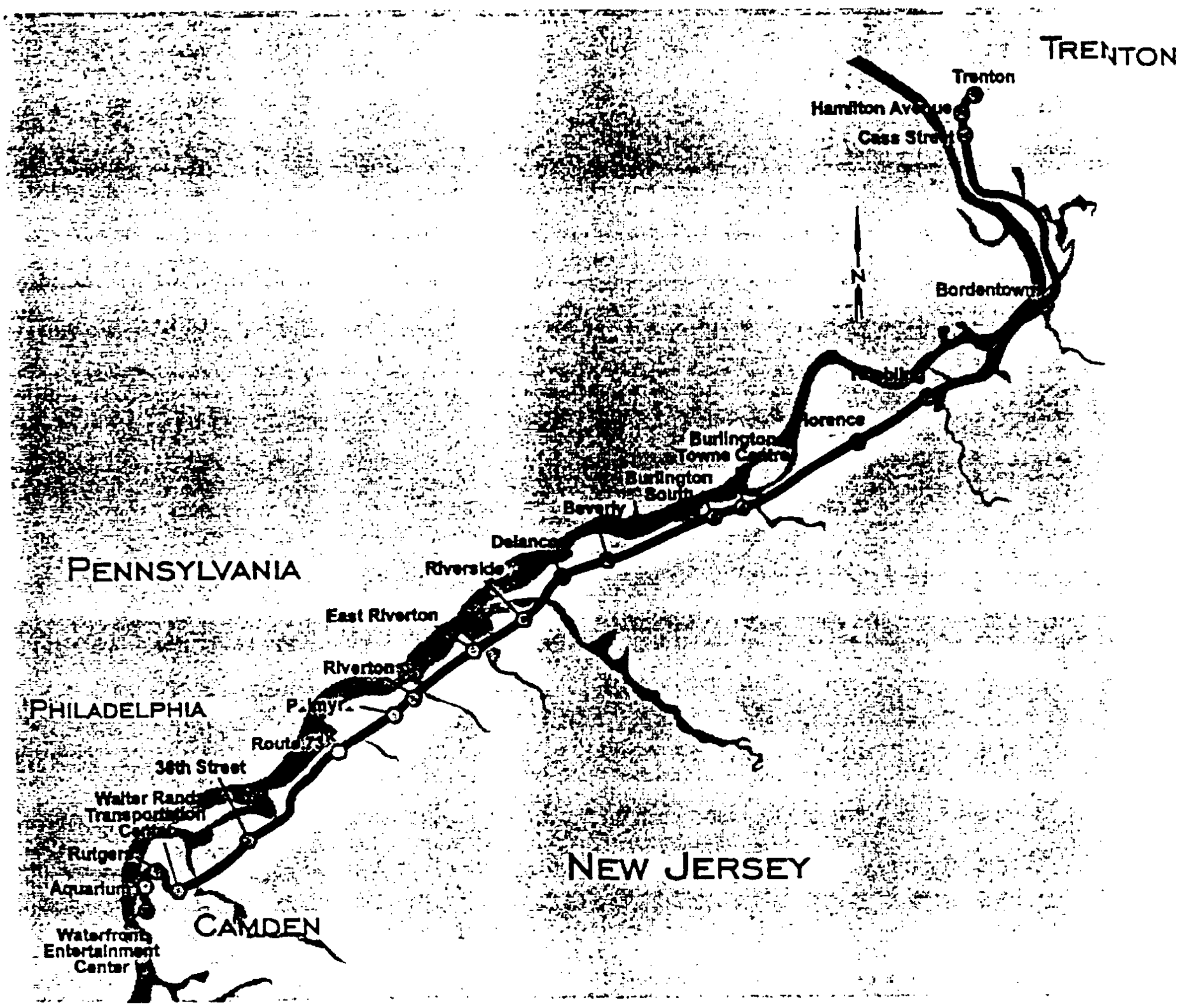
2.1.2 Station Stops

All of the proposed 20 SNJLRTS station stops are surface level. None are elevated, on bridge structures, underground or depressed. The station stops will have low-level side or center platform(s), not more than 200 feet long, with a maximum height of 24 inches above top of rail. Station stops will be unattended, and fare collection will be handled through a self-service, proof-of-payment system. Station security will be provided cooperatively by Contractor security services, local police and NJ Transit Police. Public telephones with emergency (911) access will be provided at each station stop.

2.1.3 LRT Cars

Diesel LRT Cars are proposed for use on the system. Each LRT Car will be capable of operating at a maximum speed of up to 60 mph and be able to maneuver in both street-running and railroad right-of-way (ROW). Each LRT Car will accommodate at least 75 seated passengers, with a total capacity of at least 150 passengers. A Passenger Assistance Intercom will be provided in each car to enable communication between passengers and the LRT Car operator in the event of an emergency.

Exhibit 2-1 SNJLRTS Northern Corridor System Map



2.1.4 Signaling

The signaling system will includes wayside equipment to inform LRT Car operators of safe train movements and speeds. The 54 at-grade street crossings along the mainline route will be protected with railroad-style flashers, gates, and warning bells. Operation of crossing gates will be activated automatically by approaching trains.

2.1.5 Yard & Shop, and Control Center

A yard and shop maintenance facility will be located in Camden, and will accommodate equipment for maintenance of LRT Cars, signaling equipment, communications equipment, and track. The operations and management offices will also be located at the Yard & Shop site. In addition to the Camden storage site, storage tracks will be provided in the vicinity of Trenton to permit overnight storage of 4 trains.

The Control Center will be located at the Yard & Shop site and staffed with Contractor personnel. The Control Center will provide for direct communication with all train operators, field personnel, and control of powered switches (and potentially with freight operations personnel). Control Center personnel will implement corrective actions to maintain service schedules and minimize adverse impacts from equipment failures and emergency situations.

2.1.6 Operations

The rail system will initially operate revenue service from 6 a.m. until 12 PM each day. Departure of the first trains of the day from the yard and the arrival of the last trains at the yard will *occur* slightly beyond the revenue service hours. Between 6 a.m. and 9 a.m., and 5 p.m. and 7 p.m., trains will operate at 15-minute intervals. During all other times trains will operate at 30 minute intervals.

2.2 SAFETY AND SECURITY FEATURES

The SNJLRTS Technical Provisions, Book V defines requirements for various safety and security features. The requirements are subject to review and revision, by prescribed procedure, as the design evolves.

2.2.1 Communications

Customers will be able to contact emergency services from any station within the system through the use of public telephones. The Communications system will include:

- Vandal resistant public telephones at each station stop
- A public address system on the passenger vehicles
- A passenger assistance intercom on the passenger vehicles
- Smoke detectors and fire alarms in yard, shop, and control center
- Fixed and portable radios for operations, maintenance, yard, security, and management personnel.

2.2.2 Signaling and Track

The design of the signaling system will be Federal Railroad Administration (FRA) compliant. The Design will comply with all relevant aspects of the Association of American Railroads (AAR), the American Railway Engineering Association (AREA), and other applicable codes and standards. The design will assure that any single, independent component failure will be unlikely to result in an unsafe condition.

2.2.3 Stations

All station stops will be lighted according to the standards of the illuminating Engineering Society Handbook, the National Electric Safety Code, and local codes/ordinances. Building materials and finishes will comply with the BOCA Basic Building Code and/or NFPA standards, as applicable.

Station stops, equipment and vehicles will provide ease of access for disabled and elderly passengers in compliance with the Americans with Disabilities Act (ADA). Graphics and signs will be uniform in placement, presentation and will be well illuminated.

2.2.4 LRT Cars

The LRT Cars will be of a service proven design and incorporate various features that provide for operator and passenger safety, including:

- Positive train separation and automatic train stop
- Door circuitry and sensitive door edges to stop the train should an unauthorized door opening occur
- Manual door release controls
- Handholds and stanchions
- Anticlimbers and collision posts to protect passengers
- Safety glazing, compliant with FRA standards
- Normal and emergency, interior and exterior lighting
- Train radio, passenger intercom, and silent alarm
- Materials selected for resistance to flame spread and smoke generation.

2.3 SNJLRTS Organization

The organization of the SNJLRTS Project is shown in Exhibit 2-2. As shown, the SNJLRTS project team consists of three organizations: New Jersey Transit (NJT), the General Design Assistance Consultant (GDAC) represented by DMJM·BA&H, and a Contractor that will be selected at a later date. Under the authority of the NJT Project Director, the GDAC is responsible for preliminary engineering design and preparing the Contractor solicitation package. The Contractor is required to have a Quality and Safety Assurance Manager who will chair the Safety Committee (see Section 3.6) and oversee all safety activities during design, construction, and operation and maintenance phases of the project.

NJT has overall responsibility for ensuring that the system meets the highest standards of safety and security set forth in this SSPP. Under the direction of the NJT Senior Director of New Rail Construction, GDAC has responsibility for carrying out the day to day activities required to incorporate safety into the preliminary design of SNJLRTS. In addition, GDAC is responsible for helping NJT establish the safety requirements that will ultimately be implemented by the selected Contractor.

The GDAC project organization is shown in Exhibit 2-3. The Quality and Safety Assurance Manager, who reports directly to the GDAC Project Manager, is responsible for implementing system safety activities during preliminary engineering. This organization structure allows the Quality and Safety Assurance

Manager to report any safety concerns directly to the GDAC Project Manager, avoiding the competing priorities of the other disciplines. Upon completion of preliminary engineering, the primary responsibility for system safety will be transferred to the Contractor, with auditing by the NJT SNJLRTS Project Director. When revenue operation begins, oversight responsibility for the project will likely be transferred to the Operations Division within NJT. The selected Contractor's organization will be defined in a revision to this document. The Contractor will identify a specific person within their organization who has full responsibility for overseeing the implementation of the SSPP during final design, construction, testing, and revenue operations.

Exhibit 2-2 - SNJLRTS Project Organization

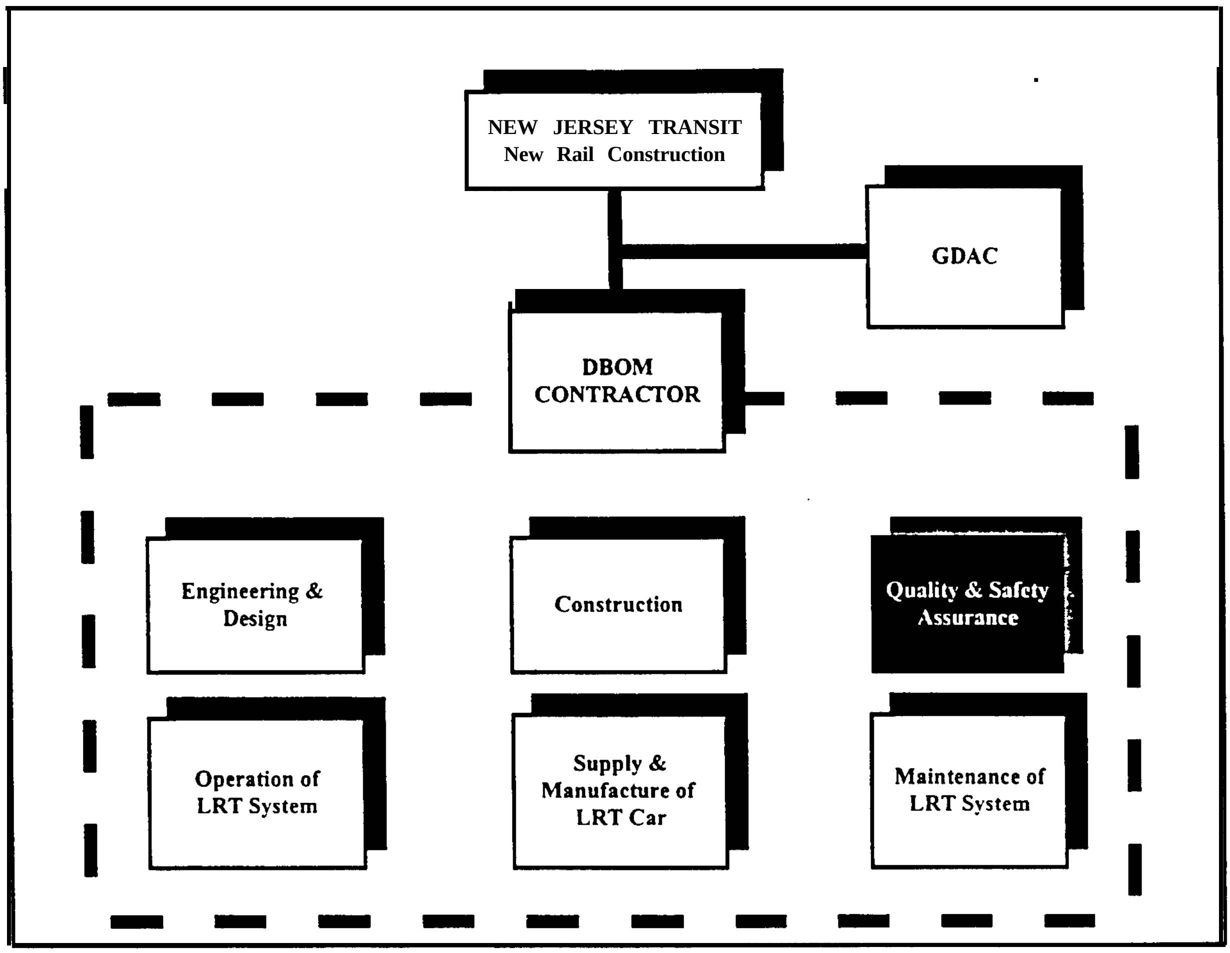
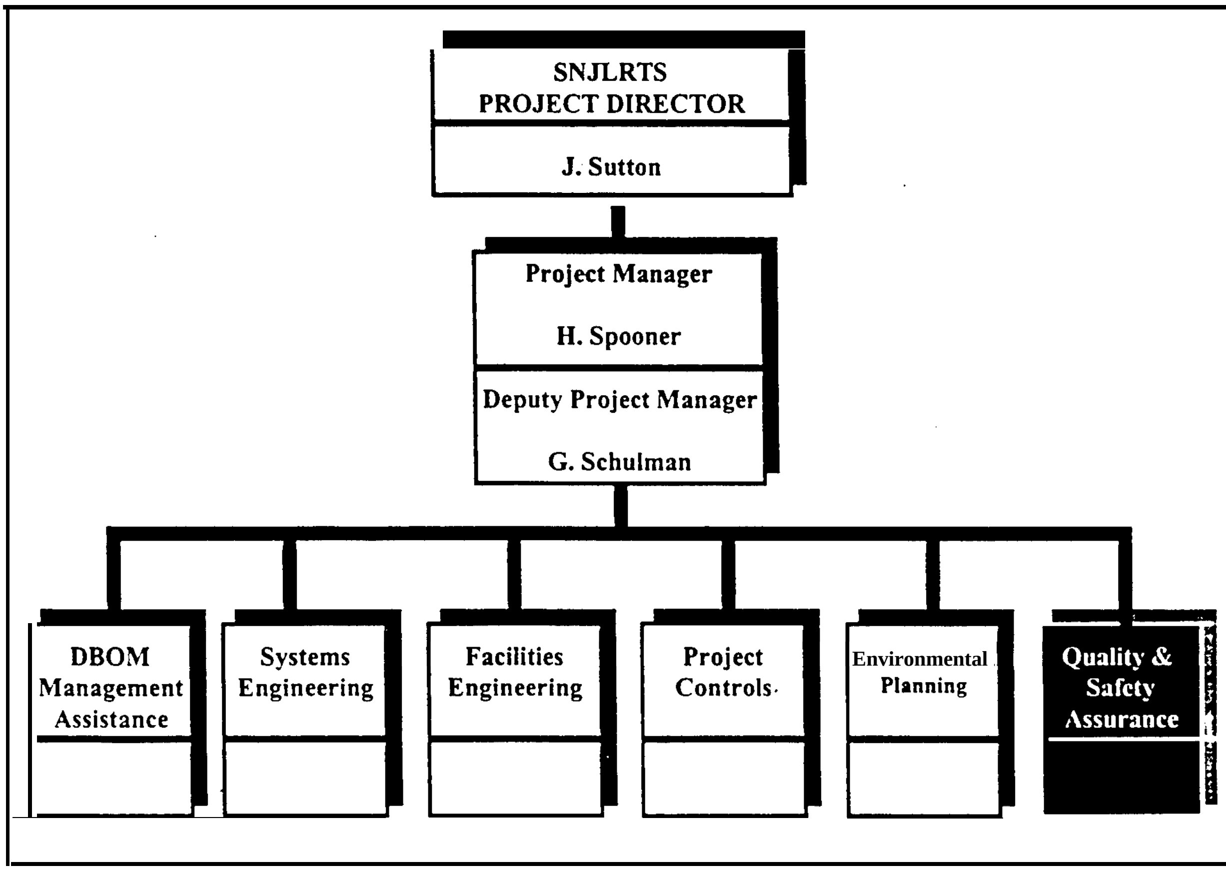


Exhibit 2-3 - General Design Assistance Consultants (GDAC) Organization



3 SAFETY PROGRAM ACTIVITIES

This chapter identifies and describes the system safety tasks that will be performed during preliminary engineering, final design, construction, pre-revenue testing, and revenue operations.

Exhibit 3-1 lists the safety tasks, which are presently identified for the SNJLRTS Project. Task numbers in the left-hand column of Exhibit 3-l correspond to the paragraph numbers used in this chapter. The organization with primary responsibility for preparing and directing each task is also shown, along with a task completion schedule. Exhibit 3-2 illustrates the interrelationship between the safety program activities.

3.1 PRELIMINARY HAZARDS LIST

A Preliminary Hazards List (PHL) is a systematic, high-level examination of the proposed design to identify hazards to customers and employees. The purpose of the PHL is to develop safety design requirements for the system and establish the framework for subsequent safety analysis. It provides information about potential hazards, assigns hazard severity categories and lists measures to reduce the hazards. A PHL addresses the vulnerability of system functions; it is not an assessment of any particular hardware or software design. A PHL is qualitative and is conducted using experienced engineering judgment.

A PHL will be maintained by the GDAC during preliminary engineering and approved by the NJT Office of New Rail Construction. A form for completing the PHL is illustrated in Exhibit 3-3.

3.2 TECHNICAL PROVISIONS

As part of its preliminary design responsibilities, the GDAC will determine the codes, guidelines, and regulations applicable to the design of a safe system. The identified requirements have been incorporated in the SNJLRTS Technical Provisions, Book V, and form the basis for GDAC and Contractor designs of equipment and facilities. The design criteria will be integrated into all aspects of design, architectural concepts, specification preparation, equipment selection, construction and operations.

Applicable standards, codes, and requirements will be derived from several sources including the following:

- Association of American Railroads (AAR)
- American Railway Engineering Association (AREA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Occupational Safety and Health Administration (OSHA)
- National Fire Protection Association (NFPA)
- United States Department of Transportation (USDOT)
- New Jersey Department of Transportation (NJDOT)
- Americans with Disabilities Act (ADA)
- Underwriter's Laboratories (UL)
- Building Officials and Code Administrators (BOCA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Military Standards, Specifications, and Handbooks Uniform Construction Code (UCC).

Safety related changes to the Technical Provisions would be coordinated through the Safety Committee for review and approval.

Exhibit 3-1 - Safety Program Tasks and Schedules

Task No.	Task	Schedule	Primary Responsibility
3.1	Preliminary Hazards List	Preliminary Engineering	
3.2	Manual of Design Criteria	Preliminary Engineering	GDAC
3.3	Safety Certification Plan	Preliminary Engineering	
3.4	Configuration Management Program	60 days after DBOM Contractor NTP	DBOM
3.5	Hazard Identification and Resolution Process	90 days after DBOM Contractor NTP	Contractor
3.6	Safety Committee	90 days after DBOM Contractor NTP	
3.7	Failure Modes & Effects Analysis	Pre-final Design Review	
3.8	Operating Hazard Analysis	Pre-final Design Review	
3.9	Hazardous Materials Program	Final Design	
3.10	Employee Safety Program	Final Design	
3.11	Safety Certification Implementation	Final Design through Pre-revenue Operations	
3.12	Emergency Equipment Requirements	Construction	
3.13	Emergency Training and Distaster Drills	Pre-revenue Operations	
3.14	Normal and Emergency Operating Procedures	Construction	
3.15	External Agency Coordination	Construction	
3.16	New Jersey Department of Transportation (NJDOT) and APTA Safety Review	Pre-revenue Operations	NJ Transit
3.17	Accident/Incident Investigation and Reporting Procedures	Pre-revenue Operations	DBOM
3.18	Internal Safety Audit Process	Pre-revenue Operations	Contractor
3.19	Drug and Alcohol Abuse Program	Pre-revenue Operations	

Exhibit 3-2 - Inter-relationship of Safety Tasks

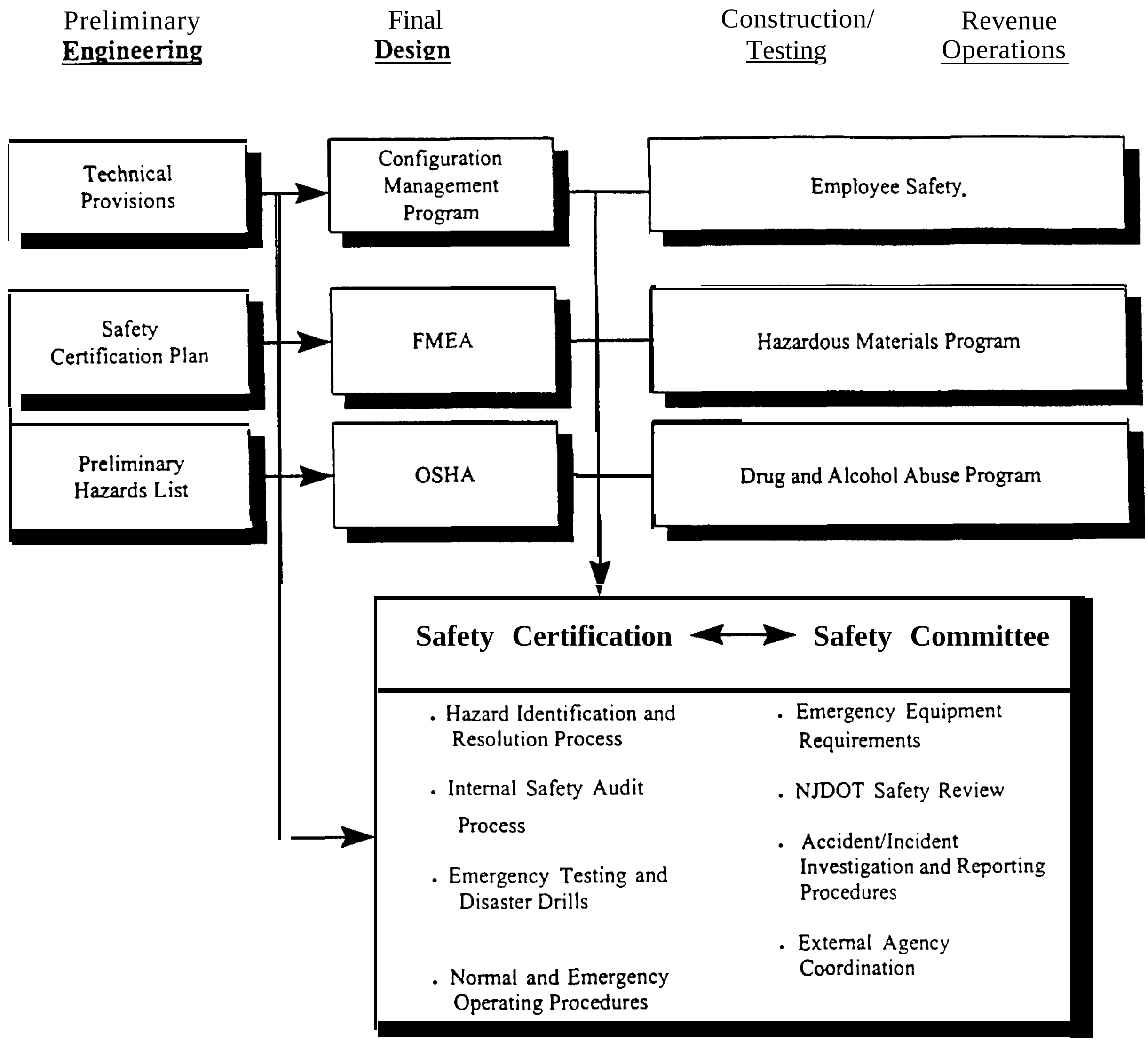


Exhibit 3-3 - Preliminary Hazards List Form

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Page ______ of ______

Prepared by: ____________________ Date: ____________________

Approved by: ____________________ Date: ____________________

System Element: ____________________

Hazard Severity:

I Catastrophic II Critical

III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Transit System	Hazard Severity	Possible Controlling Measures and Remarks	Resolution

3.3 SAFETY CERTIFICATION

Safety certification is the process of verifying satisfactory compliance with a set of formal safety and security requirements, The scope of the safety certification program will be defined in the Safety Certification Plan prepared by GDAC and approved by the NJT Office of New Rail Construction. The Plan will identify documentation requirements and establish certification procedures for the collection, review and approval of evidence needed for certification.

- The safety certification program is designed to:
- Establish a formalized process which is sufficiently documented to verify compliance with safety requirements
- Ensure that safety is an integral part of design, procurement, construction, testing, and operations
- Provide information for periodic reports to NJT senior management, and outside agencies
- Verify that any hazards that become apparent during design reviews, inspections, or system testing are resolved, either by redesign or by implementation and enforcement of special procedures
- Verify that the Contractor and outside agencies are prepared to respond to normal, abnormal, and emergency situations.

The safety certification program will require documentation to verify that:

- Safety-related design criteria are properly reflected in procurement and construction specifications and drawings
- Safety-related requirements in the specifications are incorporated into the final products
- Tests are conducted to verify the ability of equipment and personnel to function safely
- Plans, procedures, and training programs are developed and thoroughly reviewed prior to the start of revenue service
- Responsible program participants certify the above to provide a traceable history of the safety program.
- The Safety Certification Plan will identify all system elements requiring certification, including:
- Systems -- including the passenger vehicle, signaling, and communications
- Operating Rules/Procedures -- including Accident/Incident Investigation and Reporting Procedures, Vehicle Operating Instructions Handbook, Operator's Rulebook, and Standard Operating and Emergency Procedures
- Training Programs -- including vehicle operators, maintenance staff, controllers, and emergency response personnel.

3.4 CONFIGURATION MANAGEMENT PROGRAM

Configuration management is a process which ensures that all property, equipment, and system design elements are accurately and completely documented. The configuration management process must include, as a minimum, procedures for authorizing configuration changes, the process for incorporating these changes into all appropriate documentation, and the process for ensuring that all necessary departments, including Quality Assurance & Safety, are formally made aware of such changes. The Contractor will prepare and implement a configuration management program within 60 days of NTP.

3.5 HAZARD IDENTIFICATION AND RESOLUTION PROCESS

A formal hazard identification and resolution procedure is required to verify potential hazards are systematically identified, evaluated, and resolved during SNJLRTS design, construction, testing, and revenue operations. Hazard identification and subsequent resolution are based on information from:

- Design reviews where representatives of safety, security, and operations participate
- Hazard analyses and special reports prepared by consultants, SNJLRTS staff, contractors and suppliers
- Information from other transit systems
- Observations and experiences of program participants during construction, testing, and operations.

During preliminary engineering the hazard identification and resolution process is guided by the preparation of a Preliminary Hazards List (PHL). The PHL is prepared by GDAC and helps guide the preparation of other project documents such as the Technical Provisions, Operating & Maintenance Specification, Technical Specifications, and Standard and Directive Drawings.

During their final design, the Contractor will expand the hazard identification and resolution process to include Failure Modes and Effects Analyses (FMEA) and Operating Hazard Analyses (OHA), if appropriate. A formal procedure will be prepared to document:

- Hazard analysis review and approval procedures
- Guidelines and approval processes for resolving identified hazards
- A means for all project staff to identify potential hazards which are observed during construction testing, or operations.

3.5.1 Hazard Categories

All identified SNJLRTS hazards will be categorized into one of four hazard severity levels, which are defined in Exhibit 3-4. These definitions have been adapted from MIL-STD-882C.

Exhibit 3-4 - SNJLRTS Hazard Severity Categories

Description	Category	Definition
CATASTROPHIC	I	Death, system loss, or severe environmental damage
CRITICAL	II	Severe injury, severe occupational illness, major system or environmental damage
MARGINAL	III	Minor injury, minor occupational illness, or minor system or environmental damage
NEGLIGIBLE	IV	Less than minor injury, occupational illness, or less than minor system or environmental damage

3.5.2 Hazard Probability

The probability that a hazard will occur during the planned life expectancy of the system can be described in potential occurrences per unit time, events, items, or activity. For the SNJLRTS, the following qualitative hazard probability ranking, identified in Exhibit 3-5 has been established:

Exhibit 3-5 - SNJLRTS Hazard Probability Levels

Description	Level	Specific Item	Fleet/Inventory
FREQUENT	A	Likely to occur frequently	Continuously experienced
PROBABLE	B	Will occur several times in the life of an item	Will occur frequently
OCCASIONAL	C	Likely to occur some time in the life of an item	Will occur several times
REMOTE	D	Unlikely but possible to occur in the life of an item	Unlikely but can reasonably be expected to occur
IMPROBABLE	E	So unlikely, it can be assumed occurrence may not be experienced	Unlikely to occur, but possible

3.6 SAFETY COMMITTEE

A Safety Committee will be established to coordinate the safety-related activities'of all project participants. Along with its coordinating responsibilities, the Safety Committee will act as a review board for activities, analyses, and reports on safety-related issues, and disseminate safety information both internally and externally. The organization of the Safety Committee will be the responsibility of the Contractor and will include representatives from NJT management, local police departments, emergency response agencies, and SNJLRTS operations and safety managers.

The Safety Committee will meet periodically (at least monthly) and is expected to function throughout all phases of the SNJLRTS project. Its emphasis will shift from design reviews early in the SNJLRTS project to the development of operating requirements which will include the review and approval of operating procedures and the development of reporting requirements as they pertain to accidents, injuries, and unsafe conditions.

The roles, responsibilities, and membership of the Safety Committee shall be defined in a Committee Charter, including:

- Reviewing revisions to safety and security related design criteria
- Reviewing and commenting on safety-critical specifications and drawings throughout all stages of design
- Coordinating construction activities with local fire and police jurisdictions
- Coordinating an integrated emergency response plan, an Emergency Response Familiarization Program, and interagency agreements
- Approving SNJLRTS readiness for revenue operations through the Safety Certification Plan
- Resolving hazards which are identified throughout all phases of the project through the Hazard Identification and Resolution Program.

3.7 PREPARE FAILURE MODES & EFFECTS ANALYSIS

A Failure Modes and Effects Analysis (FMEA) is a systematic, comprehensive, bottom-up evaluation that analyzes the effects of potential failures in a subsystem, as installed, from design data. The procedure assesses the impact of these failures on subsystem and system operation, and consequently on the operational safety of the transit system. Information provided in the FMEA includes:

- A system overview including schematics
- Identification of single-point failures and hazard-level classification, which should confirm the adequacy of fail-safe design features.
- Identification of potential hazards due to significant multiple failure conditions involving latent and undetected failures
- Identification of additional analyses, such as fault trees, or design changes which may be required
- Documentation of the effect of significant design changes.

Based on the PHL. all subsystems which can cause or contribute to Category I or II hazards will require the preparation of a FMEA. A sample form for completing the FMEA is provided in Exhibit 3-5. Each FMEA should include a description of the subsystem under review, schematics, and a complete list of equipment that will be analyzed.

3.8 OPERATING HAZARD ANALYSIS

The purpose of the Operating Hazard Analysis (OHA) is to evaluate the adequacy of procedures. The OHA examines the potential for hazards introduced by human errors. The analysis is applied to operating and maintenance procedures for critical systems to ensure that unwanted system effects are not caused by operator errors or incorrect maintenance. The OHA is carried out in a similar fashion as the FMEA, except that "tasks" and "error modes" are examined instead of "components" and "failure modes."

Each OHA should begin with a description of the procedure selected for analysis, and a listing of all the tasks or subtasks within the procedure. Using the form presented in Exhibit 3-6, each task is systematically evaluated for potential errors and their effects on the subsystem and transit system. The analysis will identify specific tasks within each procedure that are prone to critical human errors, and make recommendations for reducing or eliminating the chances of those errors. All operating and maintenance procedures for subsystems which can cause or contribute to Category I or II hazards shall be analyzed with an OHA. Analyses should be performed early in the design process so that results can have a meaningful impact on final designs.

3.9 HAZARDOUS MATERIAL MANAGEMENT PROGRAM

Hazardous materials can potentially harm the environment and transit employees, and therefore special programs to control these dangerous substances are required. The Contractor will assess which environmental and occupational safety requirements are applicable to its operation and create a plan outlining the management process and procedures to meet or exceed these requirements.

3.10 EMPLOYEE SAFETY PROGRAM

An employee safety program will be implemented which meets all applicable local and federal laws. The employee safety program must incorporate the applicable New Jersey Public Employees Occupational Safety and Health Act (N.J.S.A.34:6A-25 et. Seq.), Safety and Health Standards for Public Employees (N.J.A.C.12:100), and the Federal Occupational Safety and Health Act. These requirements include elements of:

- Employee Right to Know
- Personal Protection Equipment
- Lockout and Tag-out
- Materials (non-hazardous) Handling

3.11 EMERGENCY EQUIPMENT REQUIREMENTS

To property plan for and manage emergencies, the Contractor shall prepare a list of emergency equipment requirements. The list will define what equipment is to be purchased and stored at the Control Center, at each appropriate local firehouse, on-board the passenger vehicles, at the yard and shop, etc.; how and where the equipment is to be stored; and who controls access to it. Such emergency equipment is in addition to fire protection, control, and communications systems permanently installed. Typical safety equipment procured by other rail systems, include:

- Air bag rescue and lifting system
- Axes
- Emergency Evacuation Cart
- Emergency Planks
- Fire Extinguishers
- First Aid Kits
- Flood Lights
- Hand Lights

Exhibit 3-6 FMEA Form

Failure Modes & Effects Analysis Form

SYSTEM FAILURE MODES & EFFECTS ANALYSIS

Component/LRU: ____________
Subsystem: ____________

Function of Component/LRU; ____________

Prepared By: ________ Date: ________
Reviewed By: ________ Date: ________

1. Failure Mode and Failure Cause (Include Outside Factors)	2. Mode	3. Effect of Failure on the Subsystem	4. Dispatc h Inop Yes/No	5. A) Indication to Operator B) Operator Corrective Action C) Indication to Maintenance Crew	6. Effect of Failure on Vehicle or Transit System	7. Haz. Sev.	8. Effect of Additional Failures/ Errors (Latent, 2nd, Etc.) and Remarks

OPERATING MODE
(Column 2)

NORMAL	EMERGENCY	MAINTENANCE	RESTRICTED
N		M	R

HAZARD SEVERITY
(Column 7)

I - Catastrophic
II - Critical
III - Marginal
IV - Minor

SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

Revision: ________ Page ____ of ____

Exhibit 3-7 - Operating Hazard Analysis Form

Southern New Jersey Light Rail Transit System

Operating Hazard Analysis (OSHA)

Page ________ of ________
Prepared by: ____________________
Date: ____________________
Approved by: ____________________
Date: ____________________

System: ____________________
Subsystem: ____________________
Procedure: ____________________

Hazard Severity:
I Catastrophic | II Critical
III Marginal | IV—Negligible

Hazard Description		Hazard Effect		Corrective Action	
Task No. & Description	Error and Cause Description	Effect on Personnel/System	Hazard Severity	Possible Controlling Measures and Remarks	Resolution

- Hand Tools (hammers, wrenches, saws, etc.)
- Hydraulic Jacks
- Hydraulic Tools used to gain access to and release trapped people
- Insulating aprons, mats, blankets, gloves to provide protection from electrical shock
- Pry Bars
- Stretchers

3.13 EMERGENCY TRAINING AND DISASTER DRILLS

During system testing and start-up, the Contractor will conduct emergency training and simulated disaster drills to ensure that operating personnel are adequately prepared to respond to emergencies. NJT will review and approve those procedures which will be part of the emergency drills and exercises, as well as the schedule by which they will be conducted. NJT will also witness each emergency drill and require changes to any emergency procedures found deficient based upon actual performance.

Disaster drills will simulate various emergency conditions, such as:

- Grade Crossing Accident
- Person Under Train
- Derailment
- Fatality
- Train Fire
- Train Evacuation from a bridge
- Train Evacuation from Duck Island Wildlife Refuge

3.14 NORMAL AND EMERGENCY OPERATING PROCEDURES

The Contractor will be responsible for the development of operating rules and emergency procedures. Detailed instructions describing proper response to emergencies must be developed, reviewed, integrated and rehearsed prior to revenue operations. Input to the procedures and rules is provided by representatives of the Fire Department(s) along the route, Police Department(s), and NJT.

The content of emergency operating procedures is coordinated with the Standard Operating Procedures, and covers such topics as:

- Emergency Notification
- Hospital Locations/Notification
- Train Derailment
- Train Collision
- Grade Crossing Accident
- Fire or Smoke on Train
- Fire or Smoke in Right-Of-Way
- Fire or Smoke at Station Stops
- Fire or Smoke in Control Center
- Fire or Smoke in Yard/Maintenance Facility
- Evacuation From Train - In Wetlands
- Evacuation From Train - In Wooded Area

- Evacuation From Train - Bridge
- Service Recovery
- Emergency Bus Service
- Releasing Train/Car Back Into Service
- Response to Fire Alarms
- Power Failures at Central Control
- Passenger Vehicle Alarms
- Injured/Ill Passenger
- Ill Train Operator
- Criminal Acts
- Bomb Threats
- Hostage Situation
- Hazardous Materials Leakage
- Flood
- Adverse Weather

3.15 EXTERNAL AGENCY COORDINATION

NJT and the Contractor will work cooperatively with other external agencies to ensure that safety requirements for SNJLRTS are achieved. Written agreements outlining agency jurisdiction, communication channels, responsibilities of both parties, and financial arrangements shall cover those items listed below:

Fire Departments

- Levels of service (equipment, personnel, etc.) to be delivered in response to various types of transit emergencies
- Procedures for notification, control, and degree of responsibility on-site
- Appropriate methods of communication and transfer of command
- Training for personnel
- Use of tools, equipment, and NJT/DBOM contractor personnel to assist fire fighting and rescue operations
- Removal and restoration of power
- Participation in periodic drills

Emeraencv Medical Services

- Level of service (equipment, personnel, etc.) to be delivered in response to various types of transit emergencies
- Procedures for notification, control, and degree of responsibility on-site
- Familiarization of personnel with the rail transit system
- Participation in periodic drills

Police Departments

- Understanding of jurisdictional responsibilities
- Appropriate methods of communication and coordination
- Procedures corresponding to the types of emergency service anticipated (e.g., crowd control, authorized access control to yard and shop, hostage situations, etc.)

Adjacent Railroads and Shared Track Operations

- Procedures for risk management in joint corridor emergency incidents
- Agreements on the principal points of reciprocal contact when emergencies occur
- Information exchange methods regarding procedures for hazardous material or excess dimension movements on adjacent railroads and shared track
- Agreements on handing over operations from light rail transit to freight and vice-versa

Public Utilities

- Procedures with local public utilities regarding points of contact in an emergency, and services to be provided

3.16 NEW JERSEY DEPARTMENT OF TRANSPORTATION (NJDOT) REVIEW

The New Jersey Department of Transportation (NJDOT) will review and approve the SNJLRTS SSPP prior to revenue operations. The SSPP must be prepared in accordance with the New Jersey State Safety Oversight Program for Fixed Guideway Systems, System Safety Program Standards. In addition, the SSPP must comply with the 23 points covered in the APTA Manual for the Development of Rail Transit System Safety Program Plans, August 20, 1991.

Well in advance of the anticipated revenue operations date, the Contractor with assistance from NJT, shall undertake a review of their current SSPP to determine whether any changes are required prior to submitting it for review and approval by NJDOT. The SSPP forms the basis for NJDOT audits, and therefore it is important that the Plan accurately reflect the intentions of the Contractor and NJT. The Contractor should contact NJDOT during integration testing in order to coordinate their efforts regarding the SSPP. The SSPP shall be submitted to NJDOT prior to the anticipated revenue operations date. The Plan should be submitted to provide sufficient time for NJDOT to complete its review process and allow the Contractor to incorporate any required changes prior to revenue operations.

3.17 ACCIDENT/INCIDENT INVESTIGATION AND REPORTING PROCEDURES

The Contractor shall follow the “NJDOT Standards for Establishment of System Safety Program Plans for Fixed Guideway Systems” and “NJDOT Investigation Procedures” for reporting and investigating of accidents and unacceptable hazardous conditions, which include:

- Notification of NJDOT and NJT of all accidents and unacceptable hazardous conditions
- Follow-up reports and submittal of accident and unacceptable hazardous condition findings to NJDOT and NJT
- Submission of final written reports, corrective actions, and other follow-up activities.

The Contractor will prepare procedures that establish requirements and responsibilities for the investigation and follow-up reporting of all rail-related accidents and incidents that occur on SNJLRTS. The types of accidents/incidents covered will include:

- Train collisions with other trains, work equipment, people, obstacles, and facilities
- Train derailments, split switches, signal failures; in the yard, shop or on the main line
- Fires, explosions, or smoke conditions

- Any evacuation of passengers or employees from trains or stations
- Employee casualties or occupational injuries related to operations or maintenance
- Passenger or trespasser casualties that occur on the system
- Any other unusual occurrence that impacts safety.

A draft procedure shall be developed during pre-revenue operations. Based on emergency accident drills, a final procedure shall be completed before the start of revenue service

The draft investigation and reporting procedure shall include:

- A general on-site inspection
- Visual examination and measurements of individual items and components, parts, or software simulation or re-construction
- Nondestructive examinations by radiographic, ultrasonic, magnetic particle and liquid dye penetrate testing Functional testing of vehicle, track, signal, traction power, communications hardware and software
- Interviews with principals involved
- Meetings with investigative teams, consultants, review boards, etc.
- Review of maintenance procedures and historical events
- Review of documented hazards which might be related to the event
- Review of employee training and certification or re-certification records
- Review of photographs, drawings, and sketches
- Review of operating rules and procedures
- Review of drug and alcohol test results
- Review of hours of service records
- Review of recorded operational data and communications
- Review of police and coroner reports

Accident/incident submitted to NJ Transit and NJDOT shall include the investigation results and will indicate any corrective action(s) that may necessary.

3.18 INTERNAL SAFETY AUDIT PROCESS

System Safety is a formal process of managing a safety program to ensure that all identified safety elements in a given environment are in place and performing as designed. The internal safety audit process is the method used to determine if all organizational elements, equipment, procedures, and functions are performing as intended, from a safety perspective. The audit process must be part of a program that includes an approved implementation plan. The plan must contain, as a minimum, the following:

- Audit responsibility
- Employee safety program verification
- Verification of employee training and retraining programs
- Audit reporting to all levels of management
- Advance scheduling to help audit be less obtrusive
- Use of checklists which are provided in advance
- Formal documentation for all aspects of the internal audit
- Follow-up/corrective action

3.19 DEVELOP A DRUG AND ALCOHOL ABUSE PROGRAM

A program shall be developed that meets the requirements of the Federal Department of Transportation Drug Testing Requirements. An internal audit review process is also required to insure that monitoring, reporting, testing and other requirements of the program are met.

4.0 SYSTEM SECURITY PLAN

Following the Final Rule on RIN 2131-AA39 of 49 CFR Part 659, the Federal Transit Administration (FTA), Department of Transportation (DOT), requires the System Safety Program Plan (SSPP) to include specific provisions addressing security matters, intentional wrongful or criminal acts, such as muggings, rapes, murders, assaults, or terrorist activities. For public safety, the FTA also allows the security portion of the SSPP to be barred from public disclosure.

The SNJLRTS System Security Program Plan follows the FTA Transit System Security Program Planning Guide to address the security and law enforcement issues related to the SNJLRTS. As permitted by the FTA Final Rule, the Security Program Plan included as Appendix A of the SSPP, is presented in a separate cover so its circulation can be restricted.

APPENDIX A - SYSTEM SECURITY PLAN

APPENDIX A - TABLE OF CONTENTS

Appendix A - List of Exhibits

EXECUTIVE SUMMARY

It is the objective of New Jersey Transit (NJT) to provide secure, safe, and reliable service to its passengers while minimizing vandalism and property destruction associated with the LRT Cars and facilities of the Southern New Jersey Light Rail Transit System (SNJLRTS). NJT is committed to the security and safety of passengers and employees who utilize the SNJLRTS. As part of its commitment to security, a System Security Plan (SSP) has been developed.

The overall goals of the SSP are to maximize the level of security and to minimize the costs associated with the intrusion of, or destruction to, the SNJLRTS. This effort will be shared by all employees, requiring them to bring any conditions perceived to affect security to the attention of the Chief of Police, NJT Police Department (NJTPD) and the NJT Director for New Rail Construction responsible for the SNJLRTS.

The SSP formalizes security in concert with safety as the top priority for the SNJLRTS. NJTPD will have responsibility for the safety of patrons using the SNJLRTS. The Contractor will have responsibility for the security of all fixed assets of the SNJLRTS, and will engage local police in municipalities the SNJLRTS traverses, for law enforcement support, when required. NJTPD will coordinate with the Contractor to ensure that this SSP is successfully implemented.

Revision 3.0 of the SSP establishes a framework for the security activities to be accomplished during the early phases of the project. It serves as a starting point for communication between different project participants responsible for security of the SNJLRTS. The SSP must be maintained and updated throughout all phases of the project to reflect the security strategies being implemented.

1 INTRODUCTION TO SYSTEM SECURITY

1.1 BACKGROUND

Following the Final Rule on RIN 2131 -AA39 of 49 CFR Part 659, the Federal Transit Administration (FTA), Department of Transportation (DOT), requires the System Safety Program Plan (SSPP) to include specific provisions addressing security matters, intentional wrongful or criminal acts, such as muggings, rapes, murders, assaults, or terrorist activities. To satisfy this requirement, a System Security Plan (SSP) has been developed for the Southern New Jersey Light Rail Transit System (SNJLRTS).

For public safety, the FTA Final Rule allows the security portion of the SSPP to be barred from public disclosure. As a result, the SSP is provided as Appendix A to the SSPP so that its distribution can be restricted if necessary. Distribution of this document requires authorization from the NJT Project Director responsible for the SNJLRTS and the Chief of Police for the New Jersey Transit Police Department (NJTPD).

The SNJLRTS is dedicated to maximizing the safety and security of all of its passengers, employees, the LRT Cars, equipment, and facilities. A comprehensive set of security activities and programs have been established to emphasize the importance of security in all aspects of the SNJLRTS. In order to be effective, the security programs are oriented toward identifying potential security problems and implementing remedial and/or mitigating solutions before security breaches occur.

The SSP documents the security activities and programs identified to ensure a safe and orderly environment within the transit system, and to promote the confidence of the riding public, enhancing maximum use of, the transit system. In addition, the SSP emphasizes post-security-breach analysis so that appropriate and effective steps can be taken to correct, minimize, or prevent similar security breaches in the future.

NJT and the Contractor will take a proactive approach to security through the development and implementation of programs and activities, and will interface with local municipal police departments along the alignment to respond to security breaches.

The SSP will be annually updated to record the past security performance of the SNJLRTS, to identify modifications that are needed, and to establish security goals for the upcoming year.

Future revisions of the SSP will be the joint responsibility of the Contractor, NJT and NJTPD.

1.2 PURPOSE

The purpose of the SSP is to develop, establish and maintain security-related programs and activities that identify threats to, and vulnerabilities of the SNJLRTS operations. The SSP serves as a blueprint for all security activities by:

- Setting goals and objectives
- Identifying needs for security
- Defining explicitly the security roles of each person and department
- Establishing how security programs and activities are organized
- Identifying programs and activities to reduce the threats to, and vulnerabilities of the SNJLRTS

- Establishing schedule and milestones for developing and implementing he programs and activities

1.3 OBJECTIVES

The objectives of the security program employed by the SNJLRTS are:

- To develop a management structure to develop, monitor, maintain, evaluate.and modify the SSP.
- To ensure a safe environment to the riding public, employees, and general public nearby.
- To encourage passengers to use the transit system by establishing a safe and secure system record.
- To establish a working relationship with local law enforcement agencies.
- To be proactive in preventing or mitigating security problems.

1.4 SCOPE

The SSP follows the intent of the FTA Transit Svstem Security Proaram Plannino Guide [Ref. 1] and the Transit Security Procedures Guide [Ref. 2], and meets the security requirements of the New Jersey State Safety Oversiqht Proqram for Fixed Guidewav Systems, System Safetv Proaram Standards. The SSP covers the law enforcement and security programs and activities that can be used to ensure passenger, employee and public safety onboard the LRT Cars, along the alignment, at station stops and park & ride facilities, and at operations and maintenance facilities. The SSP also identifies tasks that can prevent or minimize revenue loss, theft and damage to the SNJLRTS property, and sabotage and terrorist activities.

The SSP contains the following sections:

1. Section 1 describes the purpose, objectives, and the scope of the SSP. A list of the reference documents is also included.
2. Section 2 provides an overview of the system security.
3. Section 3 identifies the tasks that ensure the security of the SNJLRTS and a framework of programs and activities that satisfy the security tasks.
4. Section 4 describes the roles and responsibilities of project participants.
5. Section 5 presents the implementation schedule and milestones of the security tasks.
6. Section 6 identifies provisions to monitor, review, evaluate and modify the SSP.

A description of the SNJLRTS is contained in the SNJLRTS System Safety Program Plan (SSPP) and will not be repeated here.

1.5 REFERENCES

The following references are used in the preparation of this document:

1. "Transit System Security Program Planning Guide," Final Report, U.S. Department of Transportation, Federal Transit Administration, FTA-MA-90-7001-94-1, DOT-VNTSC-FTA-94-1, January 1994.

2. "Transit Security Procedures Guide," Final Report, U.S. Department of Transportation, Federal Transit Administration, FTA-MA-90-7001-94-2, DOT-VNTSC-FTA-94-8, December 1994.

3. "System Safety Program Plan," Southern New Jersey Light Rail Transit System, Revision No. 3.0, RPT-T7-97-0001, October 21, 1997.

2.0 SYSTEM SECURITY REQUIREMENTS

2.1 GENERAL REQUIREMENTS

The responsibility of system security is to provide a safe, secure environment for the employees, passengers and public by preventing and safeguarding the system from crimes against property and persons. Crime may occur in many forms such as trespassing, vandalism, theft, robbery, and assault.

The security and law enforcement of the system as a whole is the responsibility of the New Jersey Transit Police Department (NJTPD). Law enforcement in particular, will be a joint effort between NJTPD and the local municipal police departments. The local municipal police departments will provide primary law enforcement in the form of response and crime apprehension for:

- Crimes occurring along the proposed alignment
- Crimes occurring at station-stops and parking facilities
- Crimes occurring onboard LRT Cars that are reported directly to them
- Emergency situations that require their immediate attention.

NJTPD will supplement primary law enforcement and crime apprehension for:

- Crimes occurring onboard LRT Cars
- Crimes against persons and property within the SNJLRTS facilities
- Crimes reported directly to them, and
- Emergency situations that require their immediate attention.

Fare enforcement officers (FEOs) will be provided by NJT. These personnel will be responsible for fare evasion and fare enforcement on-board LRT Cars and at stations stops.

The Contractor will be responsible for the security of all fixed assets of the SNJLRTS, including station stops, parking facilities, and the Yard & Shop facilities. The Contractor will provide adequate surveillance, patrols, and security devices for these locations, such as alarms and fences. The Contractor will be responsible for reporting all occurrences of crime on the SNJLRTS to NJTPD, and must cooperate fully in investigating and prosecuting the investigators of any infraction.

The Contractor will limit, and control access to the SNJLRTS facilities, equipment and sensitive information that can breach the system security. The Contractor will provide security awareness training to all employees as required by their assigned positions.

The following sections present the proposed SNJLRTS system security requirements for the following elements:

- Passengers
- Employees
- Public
- Station stops
- Parking lots
- Facilities
- Fare enforcement
- Ticket stock and revenue security
- NJTPD and local police interface
- Security program implementation and performance measurement
- Management information and reporting.

2.2 PASSENGER SECURITY

The Contractor will comply with all applicable laws and local ordinances established to ensure the safety and security of the public during use of the SNJLRTS, and will:

- report all crime activities immediately to local police and NJTPD
- assist crime victims and provide passenger assistance as appropriate
- observe the elements of the crime and provide descriptions of the incident and suspects to the investigating parties and NJTPD
- summon assistance of local police when needed
- ensure employees receive adequate training in first aid, fire prevention, and responding to security matters
- coordinate with the NJTPD and local emergency services regarding passenger accidents.

NJTPD will have primary responsibility for the safety of passengers onboard LRT Cars. LRT Car operators and field supervisors will be responsible for assisting ill passengers, and medical emergencies onboard LRT Cars.

2.3 EMPLOYEE SECURITY

The Contractor will be responsible for providing employee security on the SNJLRTS during all times of operation, and shall:

- protect operations and maintenance staff from assault, robbery, and theft of personal property
- investigate any breaches of security
- provide training in crime prevention
- control theft by employees
- report internal crime activities to the local police, and to NJTPD in a timely manner
- assist in crime investigations.

2.4 PUBLIC SAFETY

The Contractor will follow all applicable industry standards/guidelines and codes to preserve life safety on the SNJLRTS. The Contractor will be responsible for protecting the public from any hazards created by the SNJLRTS due to equipment misuse or sabotage. The Contractor will provide adequate security measures to:

- prevent equipment misuse by employees
- safeguard against security breaches by outsiders
- protect equipment in operation and in storage from sabotage.

2.5 STATION STOP SECURITY

The Contractor will provide preventive security measures at all station stops, and will engage the local police to provide support, as necessary. NJTPD will assist the Contractor as requested in policing of station stops along the alignment that are identified as “trouble spots”. Port Authority Transportation Corporation (PATCO) will provide primary law enforcement and crime apprehension at the Walter Rand Transportation Center (WRTC), Camden, and AMTRAK Police will have a similar responsibility at the Trenton North East Corridor Station.

The Contractor will install two public telephones at each station-stop with emergency 911 access, and will provide emergency call-for-aid stations at WRTC and Trenton stations. These call-for-aid stations will allow direct connection to NJTPD operations at Maplewood, New Jersey for dispatch response.

2.6 PARKING FACILITIES SECURITY

The Contractor will provide security at the SNJLRTS parking facilities. Should the parking facilities require a parking fee, the following measures will be required:

- adequate enforcement of parking fare and revenue collection
- assure that station stops, parking lots and walkways are adequately lit, free of graffiti and well maintained
- ensure the equipment functions correctly
- replace broken or damaged items promptly
- design all stations, parking lots, pedestrian overpasses, and facilities with the security of passengers and employees in mind. Blind corners and hiding places shall be avoided.

2.7 FACILITIES SECURITY

The Contractor will:

- be responsible for providing security to guard ancillary facilities such as Yard & Shop, and shop areas from vandalism and theft
- assure the security of property by providing the means to deter theft from facilities and persons
- secure all equipment and facilities that may present a hazard, particularly during non-operational hours, when employees are not prevalent
- provide 24-hour security for the Yard & Shop, the Control Center, and administrative offices, to prevent unauthorized access and theft control
- monitor security and install intrusion alarms at remote facilities, as necessary.

2.8 FARE ENFORCEMENT

The SNJLRTS will use a "Proof of Payment" revenue collection system, which requires passengers to be in possession of a valid ticket at all times during use of the system, NJT Fare Enforcement Officers (FEO) will be responsible for inspecting tickets, enforcing the payment of fares, and issuing citations.

2.9 TICKET STOCK AND REVENUE SECURITY

NJT will be responsible for the replenishment of tickets in Ticket Vending Machines (TVMs) and for the collection of all revenue.

2.10 TRANSIT AND LOCAL POLICE INTERFACE

The Contractor will maintain a bi-weekly liaison with NJTPD and local police departments, or more frequently, if required. The Contractor will also identify any training needs required of NJTPD, and local police regarding the use of any equipment specific to the SNJLRTS that may be used in an emergency.

2.11 SECURITY PROGRAM IMPLEMENTATION AND PERFORMANCE MEASUREMENT

NJTPD will require that the Contractor implement a security program aimed at providing a high level of security on SNJLRTS. As a minimum NJTPD will use its best efforts to ensure that crime on the SNJLRTS is no greater than exists in the surrounding area. Performance will be measured by comparing crime statistics for SNJLRTS with crime statistics for the surrounding area.

The Contractor should implement a similar program for the security of the SNJLRTS facilities.

2.12 MANAGEMENT INFORMATION AND REPORTING

NJTPD will provide management information reports on a monthly basis which record all incidences of crime on the system. Crime statistics will be reported following the format of the Uniform Crime Report for Part 1 and 2 crimes:

- Part 1 Crimes comprise aggravated assault, burglary, homicide, larceny, arson, theft motor conveyance theft, rape, and robbery

- Part 2 Incidents include criminal mischief, disorderly conduct, simple assault, stolen property, and weapon offenses.

Local municipality police agencies will be requested to provide NJTPD crime statistics for crimes occurring on or around SNJLRTS property, including the right-of-way, station stops, on LRT Cars, or facilities. Any duplication of data shall be reconciled by NJTPD.

3.0 SYSTEM SECURITY TASK DESCRIPTIONS

The objectives of the SSP listed in Section 1.3 can be achieved through a set of well-defined tasks carried out by the most-qualified persons within a specified schedule. Table 3-l summarizes the system security tasks, which are planned to help ensure that the SSP objectives are met.

Exhibit 3-1. SNJTLRTS Security Tasks

Objective	Tasks
1. Develop a management structure to, monitor, maintain, evaluate and modify the SSP.	3.1.1. Identify Security Staffing Requirements and Structure 3.1.2. Conduct Peer Reviews on Security Plans 3.1.3. Refine and Update Security-Related Criteria 3.1.4. Establish a Security Committee to Evaluate and Revise the SSP
2. Ensure a safe environment to the riding public, employees, and general public.	3.2.1. Identify Threats to, and Vulnerabilities of the SNJLRTS 3.2.2. Identify Security Equipment Needs. 3.2.3. Develop Security Operating Procedures/Rule-Book Input. 3.2.4. Identify Devices/Procedures to Enforce Grade Crossing Safety
3. Encourage passengers to use the transit system.	3.3.1. Develop a Public Education Program. 3.3.2. Identify a Media Coordinator and Spokesperson
4. Establish a working relationship with local law enforcement agencies.	3.4.1. Exchange Information Between NJTPD and Local Police 3.4.2. Identify and Develop Inter-Agency Training Programs. 3.4.3. Identify and Develop Joint Department Task Force
5. Enforce revenue and prevent unnecessary loss.	35.1. Develop Fare Inspection Policies 3.5.2. Ensure Revenue Enforcement and Field Compliance 3.5.3 Identify Security Needs the Yard & Shop, and Control Center
6. Be proactive in preventing or mitigating security problems.	3.6.1. Provide Input to Specifications and Drawings 3.6.2. Develop Community Policing Policy and Procedures. 3.6.3. Identify and Develop Training Programs for the Security Force. 3.6.4. Establish a Task Force to Oversee Special Events. 3.6.5. Conduct Security Studies to Identify Crime Trends

Detailed descriptions of these tasks are provided in the following sections

3.1 DEVELOPMENT OF SECURITY MANAGEMENT STRUCTURE

To ensure the success of the SSP, an effective security management structure must be established. The management structure must be able to direct the security staff to its full potential, and be held accountable for all security matters. Therefore, the management structure must contain elements that can develop, monitor, maintain, evaluate and modify the SSP.

3.1 .l IDENTIFY SECURITY STAFFING REQUIREMENTS AND STRUCTURE

Before a security management structure can be established, the staffing requirements must be known. The number security personnel needed to patrol SNJLRTS, the number of fare enforcement officers and security personnel assigned to the SNJLRTS facilities must be estimated. This can be achieved by an understanding of the threats to, and vulnerabilities of the system, and accounting for the availability of local police along the alignment.

The level of security coverage by time of day (weekday, weekend, and holidays) required to adequately protect passengers, employees and property must be identified. A security analysis has been performed to identify the crime pattern along the alignment before the implementation of the SNJLRTS. The analysis can aid the identification of staffing requirements in the early stages of the project.

A security-staffing plan for the SNJLRTS should be included in the operations planning documentation, and should be continually updated. The plan should compare the security personnel levels at similar light rail transit systems in the US, and recommend appropriate personnel requirements for SNJLRTS.

3.1.2 CONDUCT PEER REVIEWS ON SECURITY PLANS

The Security Plan must be reviewed thoroughly by NJT and NJTPD personnel, and objective opinions should be encouraged to assure the plan is executable. As part of the continuing development and refinement of system security, industry peer comments should be requested. Participants should include staff from NJT, NJTPD, municipal police departments, GDAC, Contractor security, and security representatives from other transit properties and FTA representatives.

A Security Planning Peer Review Committee will **be** established and meet monthly during the design/build phase; semi-annually for the first two years of operation; and annually thereafter. As part of the peer review, security issues shall be discussed and documented. **Based on peer review comments, the** SSP **shall be** updated to enhance system security.

This Committee should conduct system-wide security assessments and make sure that new procedures and facilities incorporate security in their design. This Committee may also develop and review training programs geared to security.

The Security Committee is also responsible for security reviews. These reviews:

- Determine compliance with management policies, rules, regulations, standards, codes, procedures, and assigned security responsibilities; and
- Identify organizational issues that may contribute to recurring security incidents or less effective responses to incidents.

This Committee may actively promote improved safety and security in the transit system. Activities in this area include security awareness campaigns, awards programs, and special security-related events.

3.1.3 REFINE AND UPDATE SECURITY-RELATED CRITERIA

Though the SSP is written to identify the best security strategy for consideration, it may be found that once the SNJLRTS is operational, additional security is required; additional program activities need to be put into place; additional security devices, instrumentation, and procedures need to be acquired and put into place; or that other activities are required.

It may also be found that some of the methods and procedures specified in the SSP prove to be inappropriate or ineffective and need to be changed. Other potential revisions could be necessitated by the identification of new procedures discussed at conferences or in publications, or by the generation of new forms, which are more appropriate for capturing and evaluating data. Still other examples may include security problems or breaches that had previously never occurred within the transit system.

It is clear that these influences and others could develop throughout the entire operating life of the SNJLRTS. The revision of the SSP should conform to the following outline.

1. <u>Revision Process</u>

It will be necessary to state the concept for revisions in addition to the day-to-day process for their implementation. For example, the SSP may be distributed to the Contractor's General Manager, all division heads, and every member of the security department and that abridged copies will be made available to LRT Car operators, mechanics, and administrative staff on request. Distributed copies could contain a memo, requesting that the reader/user provide comments.

Distributed SSP may each include a form for suggesting revisions or for identifying issues to be addressed. In this subsection, the Plan should also identify the procedure to be used when a modification to the program needs to be implemented immediately in order to remedy or mitigate an identified problem.

2. Review Process

The actual process used by the security department and those individuals responsible for reviewing and modifying the SSP needs to be discussed in this section. Mechanisms for including changes suggested by other department heads and/or the General Manager should be delineated. In addition, law enforcement officials may have very positive comments, which identify necessary changes. This section should state:

- The review process,
- How it is staffed
- What it is expected to accomplish, and
- An appropriate time line.

3. Implement Modifications

Revisions to the SSP can be presented in several different ways. For example, a new procedure, new staff responsibilities, or utilization of new forms may require immediate implementation. In such instances, appropriate pages of the SSP should be revised, approved, and disseminated to all recipients of the SSP. If more training is required to implement the recommendations, the training program, the dates of training, the individuals to be trained, and other appropriate information needs to be indicated. The process for accomplishing this requirement should be documented.

Revisions that can be implemented without extensive training can be instituted on an ongoing basis. These revisions can then be included in the yearly update of the SSP.

3.2 DEVELOPMENT OF A SAFE ENVIRONMENT

The SNJLRTS must ensure a safe environment for the passengers, employees, and general public coming in contact with the system. A safe environment can:

- increase ridership, and associated revenue
- provide a stabilized and reliable workforce
- encourage economic growth along the alignment.

3.2.1 IDENTIFY THREATS TO, AND VULNERABILITIES OF, THE SYSTEM

The threats to, and vulnerabilities of the SNJLRTS operations must be assessed so that they can be either minimized or removed from the system. This can be achieved by performing a threat and vulnerability assessment, which evaluates the security risks along the alignment, park & ride locations, and facilities.

A threat and vulnerability assessment consists of the following three steps (Ref. 1):

1. Threat and Vulnerability Identification

A public transit system is very vulnerable to certain types of threats, including vandalism and graffiti on buildings and equipment, pick-pocketing and purse snatching, fare avoidance, trespassing, and many other security problems. A transit system can face many threats to its security including curious children, destructive passengers, criminals, and even disgruntled workers. A potential security problem exists when these two components - threat and vulnerability - coincide.

It is impossible for a transit system to be completely secure. The Contractor will identify via risk management, the major threats to, and vulnerabilities of the SNJLRTS, and ensure the necessary security resources are applied.

Security Testing and Inspections

The primary purpose of security system testing and inspection is to assess the vulnerability of a transit system to a security threat. It can also be used to enhance preparedness and to promote security awareness.

It is recommended that the following three-phase approach (shown in Exhibit 3-2) be used to evaluate the state of security preparedness. Conducting the inspection in stages will improve problem identification, provide training opportunities for the security personnel, and reinforce the value of security throughout the system.

Exhibit 3-2. Phases of Security Preparedness Evaluation

Phase	How	Why
I. Preparedness	Confirm the security preparedness of the system. Ensure that security equipment is operable, and security instructions are readily available to security staff.	People can be expected to perform well only if their equipment, procedures, etc., is available and current.
II. Evaluation	Assess the proficiency of employees in performing within the security task description. Ensure that employees demonstrate knowledge of both how and when to use specific security measures.	The proficiency assessment, along with the preceding inspection for equipment preparedness, will decrease security problems due to unpreparedness.
III. Exercise	Evaluate complete security systems by employing exercises. Design exercises that require coordination between different segments of the security system.	This will assess how well the system functions as a whole. It will involve all levels of the security department, from supervisors to response teams, and will assess how well the security department is integrated with the rest of the transit system.

Phase I describes how equipment inspections are to be conducted with the intent of minimizing vulnerability. The following items will need to be specified:

<u>Equipment lists</u>. These include singular equipment, LRT Car, and facility lists, which describe the security equipment and their location. Lists will be used to check off the presence of security equipment.

Maintenance records. These can be in the form of logbooks, maintenance cards, or automated records of inspections, routine maintenance, tests, and equipment repairs. This information should be reviewed by an experienced security individual to ensure that the required equipment has been well maintained.

Equipment tests. These lists should describe how a particular piece of equipment should operate and what task it will accomplish. Tests should be used to spot check security equipment to ensure proper operation.

Several levels of equipment deficiencies may be identified during the inspection. Specify in general terms what constitutes acceptable levels of equipment preparedness. For instance, if a single video camera is used to monitor a station platform, the camera must be functional. If two cameras are used, then the loss of one may be tolerated for a short period of time.

Any equipment conditions found to be unacceptable during the inspection should be corrected prior to proficiency evaluation. Once the equipment tests have been completed satisfactorily and the deficiencies corrected, the security system is certified as ready for proficiency evaluation.

Phase II describes how employee proficiency evaluations are conducted. The following items will be specified:

Security records list. This is a list of the records that security staff complete regarding routine assignments and incident reports. It should be used to ensure that responsibilities are understood and are being followed.

Performance lists. These include requirements to demonstrate proficiency with equipment operation and will be tailored to individual positions.

Procedural lists. These will be used to check the employee's knowledge of the proper procedures to follow when confronting a security situation.

This phase also describes what is considered a minimum acceptable level of employee skill and stress the opportunity for instruction that this part of the inspection presents. The goal of this portion of the inspection is to bring individual proficiency up to the level at which a coordinated system exercise can be successfully conducted.

Phase III describes how to conduct a security system exercise. The following items will need to be specified:

Operational assignments. This list will provide the positions and staffing levels for security staff under different situations. It will be used to identify any deficiencies in staffing or any problems with assignments.

Operational scenario. This is a practice script, which will be used to guide a security exercise. It will describe what information will be provided to employees and what actions should be taken. The Plan may refer to the full script filed elsewhere, since the Plan may be widely distributed to individuals/security personnel who are to be tested.

Measures of effectiveness. For each of the following categories, develop a measure of effectiveness.

- Command and control
- Communications
- Effectiveness of operations
- Alternative strategies
- Security priorities
- Coordination with community
  - Police
  - Fire and rescue
  - Media.

An exercise should simulate operations in as realistic an environment as possible. The exercise should be supervised by experienced security individuals who will score the operation and prepare recommendations for improving procedures or training. Include several fully scripted operational scenarios, providing a comprehensive security system evaluation while keeping security personnel guessing as to which exercise will be conducted at any given time. This part of the inspection should be used to build teamwork among the different parts of the system and also to build confidence in their ability to handle difficult situations.

Guidelines should be provided for conducting these inspections and exercises. It needs to provide an annual schedule showing how often each type of test needs to be conducted. Routine equipment inspections should be done quarterly to encourage maintenance and to quickly identify security problems. Proficiency evaluations should be conducted annually to maintain security consciousness. In positions of high turnover (such as security guards) a more frequent evaluation may be needed.

Data Collection

Within the transit system there is a great deal of information to help a security manager allocate resources. Sources include incident and breach reports, passenger complaints, and personnel records. Identify these sources, prescribe procedures for accessing this information, and state limits on the distribution.

Beyond internal resources, the transit system needs to maintain liaisons with local police, state and federal officials, and any local organizations whose activities may affect the system. Identify sources of outside information such as local police reports and Department of Justice/Uniform Crime Reports. The collection of information dealing with possible threats and vulnerabilities to the system compliments the preparedness testing described above.

An incident report should be developed to collect information about security incidents occurring on the SNJLRTS. As a minimum, each incident report should include:

- Date/time
- Location
- Mode of the SNJLRTS affected
- Persons involved
  - employees
  - security personnel
  - passengers
- Narrative of incident
- Estimated cost of damage
- Disruption of service
- Security action taken
- Name of supervisor.

The purpose of these reports is to alert the security system to threats so that actions can be taken to improve system security. This should be spelled out clearly. These reports should be kept simple and should not be used in the investigation of liability issues or in other forms of investigation.

The security department deals with sensitive information concerning employees, passengers, organizations, and criminal activities. Procedures should be defined for safeguarding this information. Procedures should:

- limit access to records
- limit distribution of security reports,
- distribute only general and summary information in public reports.

Reports

Reports should provide summary data concerning the security information that has been collected. Three types of reports are generally used:

1. Management reports
2. Statistical reports
3. Special requests.

Periodic management reports provide upper management with the information it needs to address with general questions concerning the system's security. These reports will summarize the number of security incidents and breaches by type (i.e., lost revenue, repairs, damage claims, and liability) and the dollar value. The management summary report should be comprehensive enough to give management a clear picture of the effectiveness of system security.

Statistical reports should be used by the security staff to determine areas where problems are occurring and to identify any trends in the threats to the system. Statistical reports should be placed in categories and indicate:

- The numbers of incidents and breaches taking place,
- The number of perpetrators identified, and
- The cost to the system of the different types of security problems, and other associated information.

Security Information Flow

The methods used to collect, store, and disseminate security information throughout the system should be described here. This section should also describe methods for information storage and retrieval.

The main sources of information are incident and breach reports, inspection reports, and information from outside sources. This information should be sent to a central point of contact identified by the Plan. A security database should be developed to store, analyze, and retrieve security information. The database can be indexed by standard system identifiers such as:

- Location
- Mode
- Patron impact
- Estimated cost
- Service disruption
- Security action taken.

2. Threat and Vulnerability Assessment

Describes how the security information will be analyzed to determine where the system is vulnerable and what threats are most likely to be experienced. It should assign responsibility for security assessment, describe how the information will be analyzed and what will be done with the results.

Data Analysis

Describes how the information will be analyzed to assess the current level of security in the system Vulnerability and threat are the two major factors involved in this analysis.

- Vulnerability is defined as the susceptibility of the system to a particular type of security hazard. Vulnerabilities can be corrected, such as increasing security patrols on LRT cars, or station stops, and doing background checks on money handlers.

- Threats are specific activities that will damage the system, its facilities, or cause injury to passengers. For example, threats include the potential for personal assault and vandalism.

Vulnerability/threat analysis can be performed by first listing all of the facilities and systems that make up the transit property. Second, list all of the possible threats. Exhibit 3-3 illustrates a partial listing of a vulnerability analysis. Lists need to be derived from the information in the security system database. For example, all of the sites for inspections should be listed in the facilities and systems list. Similarly, all of the threats identified in incident reports or from police sources should be listed.

Exhibit 3-3. Example of Vulnerability/Threat Analysis

	THREATS		
FACILITIES & SYSTEMS	**VANDALISM**	**ROBBERY**	**SERVICE DISRUPTION**
YARD 8 SHOP			
CONTROL CENTER			
ADMINISTRATIVE OFFICES			
LRT CARS			
SIGNALING			
COMMUNICATIONS			
STATION STOPS			

For each facility or system on the list, an assessment should be made concerning how susceptible it is to each threat. Where a facility or system intersects with a threat, a ranking should be determined indicating the vulnerability of the system to that particular form of threat. The Control Canter, for example, might be determined to have a very low potential for vandalism and be assigned a rating of 1 on a scale of O-4 (although any scale may be used). In contrast, LRT Cars are highly vulnerable to vandalism and might be assigned a rating of 4. When the matrix is completed, it will reveal where security problems are most likely to occur.

Frequency and Severity

Once vulnerability has been assessed, there is a need to predict which threats are most likely to occur. This part of the analysis should be conducted separately from the vulnerability analysis. If it is done in conjunction with the vulnerability analysis, the evaluators may focus only on perceived threats and not on the broader vulnerability issues.

The threat analysis should rank each of the vulnerability categories based on the likelihood that the threat will occur. When a high threat coincides with a high vulnerability, security should be focused on that area.

3. Threat and Vulnerability Resolution

Describe how identified threats will be addressed. Some threats may demand emergency response; others may require a long-term project; and still others may just be accepted as part of business with no action taken. Discuss some of the factors that go into making such decisions and some of the criteria used (e.g., frequency and severity) to draw conclusions.

Emergency Response

Identify what security criteria need to be met in order to activate certain types of emergency response. Describe the mechanism for activating certain types of emergency response, including who is authorized to initiate an emergency response, what levels of response are possible, and for how long emergency responses can be maintained.

Breach Investigation

Describe how incidents will be investigated to determine the best approach to lowering the risk. The goal of a breach investigation is to determine what circumstances led to the breach. In an accident investigation, this is referred to as finding the probable cause. The following subjects should be addressed in the breach investigation and resulting report:

- Description of the breach
- Identification of the source of the threat
- Physical description of the location
- Description of equipment involved and its physical condition
- Human factors including:
- conditions at the time of the breach
- training and knowledge of procedures
- performance during the breach
- conditions resulting from the breach (e.g., injuries)
- Environmental conditions
- Actions taken to mitigate the breach
- Command and control effectiveness
- Determination of probable cause
- Recommendations.

Information on these subjects should be collected in an investigative report and submitted to management for action.

Research and Improvements

There will be some cases when the security analysis reveals a problem that does require additional study to determine how the risk can be managed. In such instances, the Contractor will provide criteria for long-term improvements in identified security-risk areas.

Eliminate, Mitigate, or Accept

There are three possible alternatives associated with security problems: eliminate, mitigate, and accept.

Eliminate – This may be done through redesign, retraining, or changing procedures

Mitigate – This requires increased surveillance, changing procedures, or bolstering the presence of security forces to mitigate a threat.

Accept – In cases where the risk is accepted, the threat has to be so remote that it is not likely to happen, or the impact on the system may not be sufficiently dangerous to warrant any action.

3.2.2 IDENTIFY SECURITY EQUIPMENT NEEDS

Specific security equipment is needed counteract specific threats. The security equipment needs must be identified and provided to the security staff. The equipment needs should reflect the staffing requirements needs identified by Task 3.1 .1. Sufficient training must be provided for use the equipment.

3.2.3 DEVELOP SECURITY OPERATING PROCEDURES/RULE-BOOK INPUT

Existing NJT operating procedures can be used as a starting point and modified to satisfy the specific needs of the SNJLRTS. As a minimum, the security-related activities carried out on a daily operating basis are outlined here. They consist of:

- Standard operating procedures,
- Emergency operating procedures, and
- Those security related tasks that are subsystems of other transit-related activities.

Standard operating procedures (SOPs) are those daily activities and tasks intended to accomplish any function within the transit system. These usually compose the rules and policies of the transit system. Only those that affect or are affected by security need be described here. However, due to the comprehensive nature of a good security program, this will include many activities. Proactive, reactive, and neutral activities will be included to whatever extent they are built into standard operating procedures.

In developing the standard operating procedures, all appropriate personnel should be included. In addition, outside sources should be consulted as necessary. All SOPs impacting security should be described here. The following are some activities that might be included:

- Operators leaving the LRT Cars for breaks
- Operators leaving the LRT Cars at the end of shifts
- Securing buildings at the close of business
- Distributing facility keys and assignment of access
- Terminating employment
- Collecting and counting revenue
- Securing other vehicles
- Securing other equipment
- Patrolling of facilities
- Daily activities of security staff
- Response to potential security breaches
- Security-related activities of station attendants and train operators
- Shift responsibilities for station attendants
- Operator procedures for handling security threats.

Emergency operating procedures (EOPs) are those special procedures for non-routine but serious occurrences, such as responding to alarms. EOPs also include contingency plans for unpredictable occurrences that may have critical or catastrophic consequences, such as power failures or natural disasters.

The responses to actual security breaches, as well as all other emergency operating procedures that may impact security should be detailed here. At the very least, the following EOPs should be described:

- Emergency reporting
- Emergency handling by security staff
- Emergency actions by front-line staff
- Dispatcher responses
- System actions for:
  - minor security breaches
  - crimes against passengers
  - violent crime
  - bomb scares
  - hostages
  - burglaries
  - other specific security breaches
- Incident investigation
- Media communications
- Contingency plans for:
  - power failures
  - natural disasters
  - terrorism.

As operating procedures are completed or updated, the SSP should be revised to reflect the current procedures in use. References from the SSP to the operating procedures should indicate:

- Title
- Separate page for each set of procedures
- Descriptive indicating affected personnel
- Level of restriction
- List of procedures
- Highlighted changes.

3.2.4 IDENTIFY DEVICE AND PROCEDURES TO ENFORCE GRADE CROSSING SAFETY

To reduce the risk to the public sharing the grade crossing with SNJLRTS, grade crossing safety must be addressed by the following steps:

- Identify grade crossings
- Identify device and procedures to enforce grade crossing safety
- Identify ordinances to penalize grade crossing violators
- Develop public outreach programs to educate drivers.

3.3 RIDERSHIP ENCOURAGEMENT

3.3.1 DEVELOP PUBLIC EDUCATION PROGRAM

The Contractor, in partnership with NJT, will develop public education programs to:

- Reduce the biased perception in crimes associated with rail transit
- Encourage would-be riders to use the SNJLRTS
- Educate the public about the advantages of using the SNJLRTS
- Inform the public how to use the SNJLRTS
- Design focus groups to enhance the quality of service

- Advise drivers regarding LRT Car grade-crossings.

3.3.2 IDENTIFY A MEDIA COORDINATOR AND SPOKESPERSON

The Contractor will inform NJT prior to making any public statements regarding the SNJLRTS operations. The Contractor will identify a single point-of-contact responsible for communication with the media. This includes TV, radio, newspapers and any concerned groups and individuals.

3.4 POSITIVE RELATIONSHIP WITH LOCAL POLICE

Since the Contractor will rely on local police departments to be the primary response unit when crimes occur on or near the alignment, the Contractor will establish a working relationship with local law enforcement agencies and coordinate with them to provide a timely response.

To aid the planning of security staffing requirements, the crime incidents and crime rates at and near the station stops, and along the proposed alignment must be known. This requires a crime incident database be established to record the required crime data so that all police departments associated with the proposed alignment can benefit from it.

3.4.2 IDENTIFY AND DEVELOP INTER-AGENCY TRAINING PROGRAMS.

Inter-agency training programs shall be identified and developed to maintain a high level of working relationship between the Contractor, NJTPD and all local municipal police departments along the alignment. The programs shall include regional emergency training and disaster drill.

If required, a special task force can be established with members from NJTPD and local municipal police departments to address special high crime areas and incidents.

3.5 REVENUE ENFORCEMENT AND LOSS PREVENTION

3.5.1 FARE INSPECTION POLICIES

NJT will perform fare inspection on the SNJLRTS in accordance with the established NJT policy.

3.5.2 ENSURE REVENUE ENFORCEMENT AND FIELD COMPLIANCE

NJT will be responsible for fare enforcement, revenue protection, and field compliance.

3.5.3 IDENTIFY SECURITY NEEDS OF THE YARD & SHOP, AND CONTROL CENTER

The Contractor will identify the security needs at the SNJLRTS facilities, to prevent and minimize loss of equipment and SNJLRTS properties.

3.6 PROACTIVE LAW ENFORCEMENT

3.6.1 PROVIDE INPUT TO SPECIFICATIONS AND DRAWINGS DURING DESIGN PHASE

The system design must have system safety and security built into the system at the early stages of the project. NJTPD will participate in the security planning undertaken during the design phase.

3.6.2 DEVELOP COMMUNITY POLICING POLICY AND PROCEDURES

NJTPD will assist the Contractor in the development of community policing policy and procedures.

3.6.3 IDENTIFY AND DEVELOP TRAINING PROGRAMS FOR THE SECURITY STAFF

Security training should be established for all personnel. All employees can assist in security planning by sharing their security concerns and ideas for improvement either through a supervisor, suggestions box, or appropriate security staff.

All training conducted in the interest of increased security, whether proactive or responsive should be described here. All types of training should be referenced, including:

- new employee orientation
- training requirements for security personnel
- special workshops, and
- any training to implement new proactive measures.

3.6.4 ESTABLISH TASK FORCE TO OVERSEE SPECIAL EVENTS

The Contractor, with services of NJTPD, and local municipal police departments should consider establishing a task force to determine the level of security staffing requirements should there be a special event that require a proactive measurement to prevent and minimize undesirable outcomes (e.g., a riot).

3.6.5 CONDUCT SECURITY STUDIES TO IDENTIFY CRIME TRENDS AND CRIME PATTERNS

To accurately identify the security impact of SNJLRTS to the public along the alignment, a security study should be conducted. During the preliminary engineering phase of the SNJLRTS, such a study was performed by the GDAC. The Contractor will be required to update this study after the start of SNJLRTS operations to ascertain the impact of the SNJLRTS to the communities the system serves.

4 MANAGEMENT OF THE SYSTEM SECURITY PLAN

The SNJLRTS Project consists of three organizations: New Jersey Transit (NJT), the General Design Assistance Consultant (GDAC), and a DBOM Contractor. NJT has overall responsibility for ensuring that the system meets the highest standards of security set forth in this SSP. GDAC has responsibility for carrying out the day to day activities required to incorporate security into the preliminary design of SNJLRTS. In addition, GDAC is responsible for helping NJT establish the security requirements that will ultimately be implemented by the selected DBOM Contractor. The DBOM Contractor shall continue GDAC's responsibility and concentrate on the design, build and operational phases of the Project.

4.1 MANAGEMENT OF THE PROGRAM

A successful SSP requires leadership from the highest levels and involvement at all levels of the SNJLRTS organization. The Chief of NJTPD is responsible for setting the security policies for SNJLRTS, which may be developed cooperatively with the Contractor and local law enforcement agencies.

The following nine management activities are required:

1. Be ultimately responsible for secure transit system operations
2. Communicate security as a top priority to all employees
3. Develop relations with outside organizations that contribute to the SSP Program
4. Develop relations with outside agencies such as the National Transportation Safety Board
5. Take appropriate action on all security concerns brought to the attention of the appropriate individual or group
6. Identify potential security concerns in any part of the transit system's operations
7. Actively solicit the security concerns of other employees
8. Serve as a liaison between the Security Committee and transit system employees
9. Work to ensure that the SSP is carried out on a daily basis

At a minimum, a procedure must exist for developing and modifying the SSP. This responsibility may be assigned to the Contractor's Security Manager or lead security officer.

4.2 SECURITY RESPONSIBILITIES

The SSP should outline all security activities and assign those functions to individuals. This portion of the SSP presents security responsibilities, which are summarized in Exhibit 4-l. Different levels of responsibilities are noted in Exhibit 4-1. An entry of "P" and "S" represents that the project participants have the primary and secondary responsibility for the task, respectively. An entry of "CR" means consultation to the specified project participants is required.

Further details on the security organization will be required from the Contractor in the SSP submitted at the Bid.

Exhibit 4-1. Security Program Responsibilities

Task	Consultants		NJ Transit		
	GDAC	DBOM	NJT	NJTPD	Comm. Relations
3.1.1. Identify Security Force Staffing Requirements and Structure	S	S	P	P	
3.1.2. Conduct Peer Reviews on Security Plans	S	S	S	P	
3.1.3. Refine and Update Security-Related Criteria		S	S	P	
3.1.4. Establish a Security Advisory Committee to Evaluate/Revise the SSP		P	S	S	
3.2.1. Identify Threats and Vulnerabilities to the System		P	S	S	
3.2.2.' Identify Security Equipment Needs	CR	P	S	P	
3.2.3. Develop Security Operating Procedures/Rule/Book Input.		S	P	P	
3.2.4. Identifv Device and Procedures to Enforce Grade Crossing Safety		S	S	P	CR
3.3.1. Develop Public Education Program		S	s	S	P
3.3.2. Identify a Media Coordinator and Spokesperson			P		
3.4.1. Develop Information Exchange System Between NJTPD & Local PD's		S		P	
3.4.2. Identify and Develop Inter-Agency Training Programs		S		P	
3.4.3. Identify and Develop Joint Department Task Force		S		P	
35.1. Develoo Fare Insoection Policies	CR	S	P	S	
3.5.2. Ensure Revenue Enforcement and Field Compliance		S	P	S	
3.5.3 Identify Security Needs at Yard, Shop, and Control Center		P	S	S	
3.6.1. Provide Input to Specifications and Drawings During Design Stage			S	P	
3.6.2. Develop Community Policing Policy and Procedures			S	P	RC
3.6.3. Identify and Develop Training Programs for the Security Force		S	S	P	RC
3.6.4. Establish Task Force to Oversee Special Events		S	S	P	
3.6.5. Conduct Security Studies to Identify Crime Trends and Crime Patterns		P		S	

5 IMPLEMENTATION SCHEDULE AND MILESTONES

5.1 IMPLEMENTATION SCHEDULE

To carry out the SSP implementation, a time line or schedule with specific milestones will be developed. The schedule should proceed chronologically from the completion of the SSP document to the beginning of the yearly plan modification process. This schedule should include specific dates for each task required for implementation.

A typical schedule for the implementation of a new Plan is shown in Exhibit 6-1, This schedule considers a new plan being written by an active top manager with other ongoing responsibilities. The actual schedule maybe longer or shorter depending on the size of the system and the demands on the contributors to the Plan. However, shorter implementation schedules are preferred. The transit system's schedule should also include actual dates.

It would be the joint responsibility of NJTPD and DBOM Contractor to finalize the implementation schedule of the SSP

Exhibit 5-1 - Example Schedule for Implementing a Security Program

ACTIVITY	DAY
Revise Security Plan	Days 1-30
Review Transit System Security Program Planning Guide	Days 1-3
Obtain Approval to Develop Security Program	Day 4
Collect Information on Current Activities	Days 5-7
Identify and Assess Security Threats and Vulnerabilities	Days 8-10
Consult with Management Staff	Day's 8-30
Consult other Security Documents	Days 8-30
Consult with Other Transit Systems by Phone	Days 8-30
Develop Proactive Security Measures	Days 10-18
Finish Draft	Day 20
Have Plan Reviewed by Other Managers	Days 20-23
Edit Security Plan	Days 22-30
Finalize Security Plan	Day 30
Submit Plan to Board for Approval	Day 31
Revise as Necessary	Day 35
Communicate the Security Program to All Personnel	Days 36-45
Distribute "System Security" Memo to all Transit Personnel and Other Interested Personnel Endorsing the Security Plan	Day 36
Distribute Security Plan to Management Staff	Day 36
Meet with Managers	Day 38
Managers Distribute Abridged Plan, Procedures, and Assignments to All Personnel	Days 39-45
Share Security Plan with Local Chief of Police	Day 40
Establish Means to Accomplish Security and Activities	Days 39-69
Managers and Supervisors Ensure that All Subordinate Staff Understand Roles and Responsibilities, as well as Applicable Standard and Emergency Operating Procedures	Days 40-53, and ongoing
Establish Security Committee	Day 45
Obtain and Install Required Equipment	Day 39-69
Conduct Ongoing Operations With Maximum Security According to System Security Plan	Ongoing
Evaluate Security Plan Implementation and the Security	Ongoing
Program	
internal Review by Management Staff	Days 36-69 and Ongoing
Obtain External Audit	Days 120-165
Modify Security and Plan	As necessary
Schedule Security Plan Update	Day 200

6 IMPLEMENTATION AND EVALUATION OF THE SSP

6.1 IMPLEMENTATION OF GOALS AND OBJECTIVES

This section addresses how the SSP will be implemented, and how progress will be evaluated. This stage is important in establishing an effective Program, since if the SSP is incomplete, flawed, or not supported by the appropriate staff, the security planning efforts may be futile. The Plan should ensure that the:

- SNJLRTS staff understands exactly how the Program affects them,
- Program receives appropriate support from management,
- Activities described in the Plan are undertaken, and
- Tools necessary for carrying out the Plan are provided.

The primary goals of implementing the Plan will be to:

1. <u>Establish a Program</u> - After the Plan is established, this primary goal will change.

2. <u>Define and Modify the Program</u> - A number of other goals will support this primary goal. The transit system should adopt and record the implementation goals most appropriate to itself.

3. <u>Describe the Program Clearly</u> - Because the intent of the Plan is to clearly establish an effective Program, the Plan should accurately describe the transit system, the context of the Program, and the security activities. The final stages of the Plan development and initial stages of Plan implementation should include a review of the Plan for content. The Plan should reflect the current activities and procedures of the transit system. In addition, professionals (other than the authors of the Plan), should evaluate and critique the Program immediately prior to implementation. Supporting objectives may be to:

   - ensure that the Plan is comprehensive and complete,
   - ensure that all managers and supervisors understand the Objectives of e program,
   - ensure that the Plan is current, and
   - evaluate the Plan.

4. <u>Communicate the Program to All Affected Persons</u> - Supporting objectives would be to:

   - Obtain concurrence from the Board of Directors,
   - Distribute the Plan to all managers and supervisors,
   - Require managers and supervisors to communicate the Plan to staff, and
   - Resolve all questions related to the Plan and Program.

6.2 EVALUATION

It will be necessary to evaluate constantly the program during implementation. This evaluation process should extend from the initial draft of the Plan through full implementation. The evaluation must reflect the fact that system security is based on a comprehensive planning process for a program that extends throughout the entire system. Consequently, the Plan should benefit from the review and input of internal management staff as well as external audits.

During the drafting period, reviews will enhance the quality of the Plan. During implementation, the reviews will identify issues to be resolved as the program goes into effect and will provide feedback on the progress of implementation. Those areas responding slowly can receive the benefits of management attention and guidance. Evaluation at the time the program is expected to be fully implemented will identify those areas needing additional attention and will offer suggestions for improvement, either to fine-tune the Program or to implement new objectives in a revised Plan. Briefly explain how implementation will be evaluated. Two possible approaches can include Internal Review Management and External Audits.

6.2.1 INTERNAL REVIEW-MANAGEMENT

Following the development of a Draft SSP, in which security staff will have participated with assistance from other departments, managers throughout the system should evaluate the whole Plan for clarity and the specific Program it implements for comprehensiveness. Any problems with the Plan or Program identified by other managers that would hamper the accomplishment of security objectives should be worked out with the appropriate departments, and the Plan should be revised. Suggestions for changes in priorities should be submitted for future consideration and may be put on hold in favor of fine tuning the established program and proceeding with implementation.

During the implementation stage when roles and responsibilities are assigned and new programs are initiated, managers must provide constant feedback to the lead security staff. Although the supervisory staff will be busy communicating new tasks and training as necessary, managers should try to step back and assess the effectiveness of implementation. Lead security staff may want to establish weekly meetings during the initial implementation of a new Program to make use of this feedback and to smooth the implementation process.

In addition to the evaluations of managers and the security staff, members of the Security Committee should evaluate the Plan and its implementation schedule as part of their agendas. Their review of the draft Plan will ensure that the priorities recently identified will be appropriately addressed. Their review of implementation success will contribute to the enhanced effectiveness of the Plan in future years.

6.2.2 EXTERNAL AUDITS

In addition to internal reviews, regulatory agencies and peer group analyses may be used to evaluate success. These types of reviews should take place following the implementation of the program but before the Plan modification process has begun. This will enable the external reviewers to evaluate the Program in terms of its success during a normal state rather than in one of change. It also will allow lead security staff sufficient time to evaluate feedback and to prepare an effective modified Plan.

Identify those techniques that will be used to formally evaluate the transit system's Program from outside the system. It should include a schedule for requesting external audits, for contacting the executing organization, for assisting evaluators, and for discussing results.

External audits may be accomplished by the following:

Regulatory Agencies	Evaluation of the procedures for implementing the Plan may be conducted twice a year by regulatory agencies concerned with security. While the assessment of more detailed security activities of the transit system may be beyond the function of some government entities, reviewing implementation (along with objectives) may be of particular interest to funding agencies. Transit systems rely heavily on government sources for funding, and it is likely that local, state, and federal administrative agencies will want to ascertain that funding for transit programs are being well spent and are protected. Furthermore, the endorsement of the Program by regulatory agencies may help to reduce liability in the event of a serious security breach.
Insurance Companies	Many insurance companies provide risk management reviews and audits as part of their premium charges. Systems that do not self insure may want to ask their insurance companies to review the Plan and Program.
Law Enforcement Agencies	Local law enforcement agencies often offer gratis security reviews of facilities and may be persuaded to review at least parts of the Plan.
Peer Group or Consultant	The transit system should compare itself and its programs with similar systems. This can be done informally by cooperating with other systems or through more formal reviews accomplished by a consultant. Either will inject the perspective of an experienced outsider into the evaluation process. The transit system may solicit a critique from a lead security officer from another system or a transportation planning and operations professional from a private consulting firm. Outside evaluations by such sources usually yield extremely useful feedback. The results of the review process should be incorporated into normal planning activities.

APPENDIX B - SAFETY CERTIFICATION PLAN

APPENDIX B - TABLE OF CONTENTS

Appendix B - List of Exhibits

1 introduction

The primary goal of the Southern New Jersey Light Rail Transit System (SNJLRTS) is to provide safe, reliable, and cost-effective transportation. Toward this end, NJ Transit has established a comprehensive System Safety Program Plan (SSPP) for SNJLRTS. The SSPP identifies management and technical activities for each project phase to provide a degree of assurance that safety objectives will be systematically integrated throughout all phases from conceptual design through operations. A governing requirement of the SSPP is the development of a Safety Certification Plan (SCP). The objectives of the SCP will be met by documenting that:

a) the project design requirements are reflected in the mandatory documents, and other Bid documents, as appropriate

b) final designs and future changes to designs are reviewed for safety implications

c) the safety features required by Contract are properly included in the finished product(s)

d) the equipment and facilities are tested and inspected to verify that the safety features perform as the design intended

e) operations and maintenance procedures have been prepared, and evaluated during the verification process to ensure that any changes required are accomplished

f) a comprehensive system verification and testing program is developed that includes safety testing and verification of all facilities and equipment, and the capability of personnel to deal with normal, abnormal, and emergency conditions

g) emergency operations plans and procedures are developed to facilitate the coordination between NJ Transit, the Design, Build, Operate, and Maintain (DBOM) Contractor, and outside agencies for emergency response

h) any hazards that become apparent during design reviews, audits, inspections or system testing are resolved, preferably by redesign, or by implementation and enforcement of special procedures

i) plans, procedures, and training programs are developed and implemented prior to the start of revenue service

j) responsible program participants verify the above are completed in order to provide a traceable history of the certification process.

1.1 SAFETY CERTIFICATION POLICY

It is the policy of NJ Transit that a Safety Certification Plan be developed to provide sufficient evidence that SNJLRTS is operationally safe, and that all safety requirements have been complied with. Toward this end, the Safety Certification Plan must achieve the following:

a) identify and document design decisions regarding safety, fire/life safety and security

b) provide a certification program that is sufficiently formalized to document and verify compliance with safety, fire/life safety and security requirements in the mandatory documents and standard and directive drawings, during the construction and procurement of facilities and equipment

c) encourage the identification of potential hazards that affect safety, fire/life safety and security

d) enforce the integration of safety, fire/life safety and security activities as part of the design review, inspection, audit, testing and operations processes

e) affirm that NJ Transit, the Contractor, and outside agencies are prepared to respond to normal, abnormal, and emergency situations

f) identify informal/formal medium for providing senior management with progress of safety efforts

g) ensure that safety decisions are made by responsible managers from NJ Transit and the Contractor

h) provide periodic reports to NJ Transit and Contractor Management and New Jersey Department of Transportation (NJDOT) regarding the status of the certification program

The intent of the program is to provide verification that all safety-critical subsystems, procedures, and training programs have been reviewed for compliance with safety requirements prior to the start of revenue service.

1.2 SCOPE

The program scope encompasses safety certification of equipment, facilities, plans and procedures for the following:

- System-wide Elements -which include the LRT Cars, signaling, communications, fare collection, fire protection and suppression systems, and auxiliary vehicles and equipment.

- Fixed Facilities -which include line segments, bridges, station stops, Yard & Shop and Control Center.

- Safety, Security, System Assurance, Operational, and Maintenance Plans and Procedures - which include items such as the Emergency Preparedness Plan, Training Programs, Accident/Incident Investigation and Reporting Procedure, Operators Rule Book, and Standard Operating Procedures.

The safety certification program provides NJ Transit, the Contractor and NJDOT with reasonable assurance that the SNJLRTS can operate safely, consistent with accepted industry practices. It is recognized that periodic reassessments of safety certification will continue throughout the life of the system, particularly when modifications or system extensions occur.

Construction safety requirements covered by the Federal and New Jersey State Occupational Safety and Health Administration(s), are the responsibility of the Contractor and Subcontractors and are not included in this safety certification program.

1.3 BASELINE FOR CERTIFICATION

There are six major components that form the baseline for certification, as follows:

- **Book III: Project Provisions, and Book V: Technical Provisions** contain all safety and security requirements for the design, build, operations and maintenance of the SNJLRTS

- The Contractor's Final Design Specifications will be used as the basis for determining that the safety and security features of facilities, systems and equipment are in compliance with the mandatory requirements of the Technical Provisions

- The System Testing and Verification Plan will be used as a basis for determining that safety and security critical tests and inspections have been performed in compliance with codes and guidelines, and that all facilities, equipment and procedures, once integrated, can function together in a safe manner

- The Operating and Emergency Procedures Checklists will be used as a basis in determining that safety, fire/life safety, and security plans and procedures are developed, reviewed, and approved

- The Operations and Maintenance Rule Book(s) will be used to validate the effectiveness of the rules, and further, the degree to which operations and maintenance personnel are prepared to operate the SNJLRTS

- The Training Records will be used as a basis for determining that all safety related operations and maintenance training programs and drills are identified and successfully completed by the appropriate staff

- The hazard identification and resolution program will be used to determine that all potential hazards are systematically identified, evaluated, and resolved during SNJLRTS design, construction, testing, and revenue operations.

1.4 RESPONSIBILITIES

The Contractor has direct responsibility for the safe and dependable operation of the SNJLRTS, and in conjunction with NJ Transit, has direct responsibility for implementing and enforcing the safety certification program. The State of New Jersey DOT will verify the safety certification has been completed as a condition of the Contractor operating the SNJLRTS.

General responsibilities for the Safety Certification Program are summarized in Exhibit l-l. Specific responsibilities for accomplishing certification tasks are detailed herein.

1.5 DEVELOPMENT OF THE SAFETY CERTIFICATION PROGRAM

The development of the Safety Certification Program is to be accomplished in two (2) steps, as follows:

1. Development of the SCP - this step is the subject of this document; it is intended to establish the framework, policy and plans for certification

2 Development of the detailed Safety Certification Procedures - this step will be accomplished prior to Final Design by the Contractor

The above approach ensures that the certification program is sufficiently coordinated by involving all program participants in the certification process. This edition of the SCP is intended to provide an overview of the responsibilities of participants involved in the certification process, develop certification forms, and identify documentation requirements and procedures. Specific safety certification procedures will be prepared prior to Final Design to coordinate efforts with design reviews, inspections, audits, tests, and system verification.

Exhibit I-I - Summary of Safety Certification Responsibilities

ORGANIZATION	RESPONSIBILITIES
NJ TRANSIT	Through its participation on the Safety Committee, reviews and approves checklists, plans, requirements, procedures, and evidence for certification.
SAFETY COMMITTEE	Reviews and approves checklists, plans, requirements, procedures, and evidence for certification.
GENERAL DESIGN ASSISTANCE CONSULTANT	Develops Safety Certification Plan (SCP). Develops Criteria Conformance Checklists. (Performs function only until Contract is awarded. Responsibility then shifts to the Contractor.)
DBOM CONTRACTOR	Develops detailed procedures for implementing all phases of the Safety Certification Plan. Has direct responsibility for the day-to-day management of the certification program. Prepares checklists, plans, requirements, procedures, and evidence for certification.

1.6 SAFETY COMMITTEE

As part of the overall SNJLRTS system safety program, a Safety Committee will be established by the Contractor to coordinate all project safety related activities. Along with its coordinating responsibilities, the Safety Committee acts as a review board for activities, analyses, and reports on safety-related issues, and disseminates safety information both internally and externally. The organization of the Safety Committee will be the responsibility of the Contractor, but will include representatives from NJT Office of New Rail Construction, NJT Light Rail Transit Operations, and SNJLRTS operations and safety managers. Committee membership will also be requested of local police, fire, and emergency response personnel.

The Safety Committee will meet periodically (at least monthly during D/B phase) and is expected to function throughout all phases of the SNJLRTS project. The roles, responsibilities, and membership of the Safety Committee will be defined in a Committee Charter, but will include:

- reviewing revisions to safety and security related design requirements
- reviewing and commenting on safety-critical specifications and drawings throughout all stages of design
- resolving hazards through a formal hazard identification and resolution program.
- coordinating construction activities with local fire and police jurisdictions
- coordinating emergency response planning, and interagency agreements
- providing input through the Safety Certification Plan concerning the readiness of the SNJLRTS for revenue operations
- assuring regular audits and monitoring actions to address hazards or other identified safety concerns

2.0 Safety Certification Process

This chapter describes the safety certification process. The discussion of the certification process is keyed to Exhibit 2-l. As Exhibit 2-l indicates, the process will be accomplished in four (4) steps, which are described in the following sections. Certification of SNJLRTS is intended to verify the following:

- all planned safety activities are completed and properly documented prior to revenue service
- the design requirements related to safety, fire/life safety and security are properly incorporated into final specifications and drawings
- the safety, fire/life safety and security requirements in the final specifications are properly reflected in the construction/manufacture of facilities and equipment
- system-level inspections and tests are conducted
- safety-related plans and procedures are developed, reviewed and approved prior to revenue *service*
- appropriate NJ Transit, Contractor and emergency response personnel receive all the approved training and participate in training drills
- on-going monitoring, and safety awareness refresher training are part of the O/M phase

2.1 CERTIFIABLE ELEMENTS

The first step of the safety certification program is to identify the SNJLRTS elements that require certification. A preliminary list of certifiable elements is shown in Exhibit 2-2. The elements are identified in the areas of systems equipment, fixed facilities, procedures, and training programs.

2.2 CRITERIA CONFORMANCE CHECKLISTS

During the preliminary engineering phase, system-wide safety, fire/life safety, and security criteria were developed. Various industry guidelines, standards and government regulations were used as the basis for the criteria. A listing of applicable codes, regulations and standards is incorporated in Book V: Technical Provisions.

Exhibit 2-1 - Safety Certification Process Overview

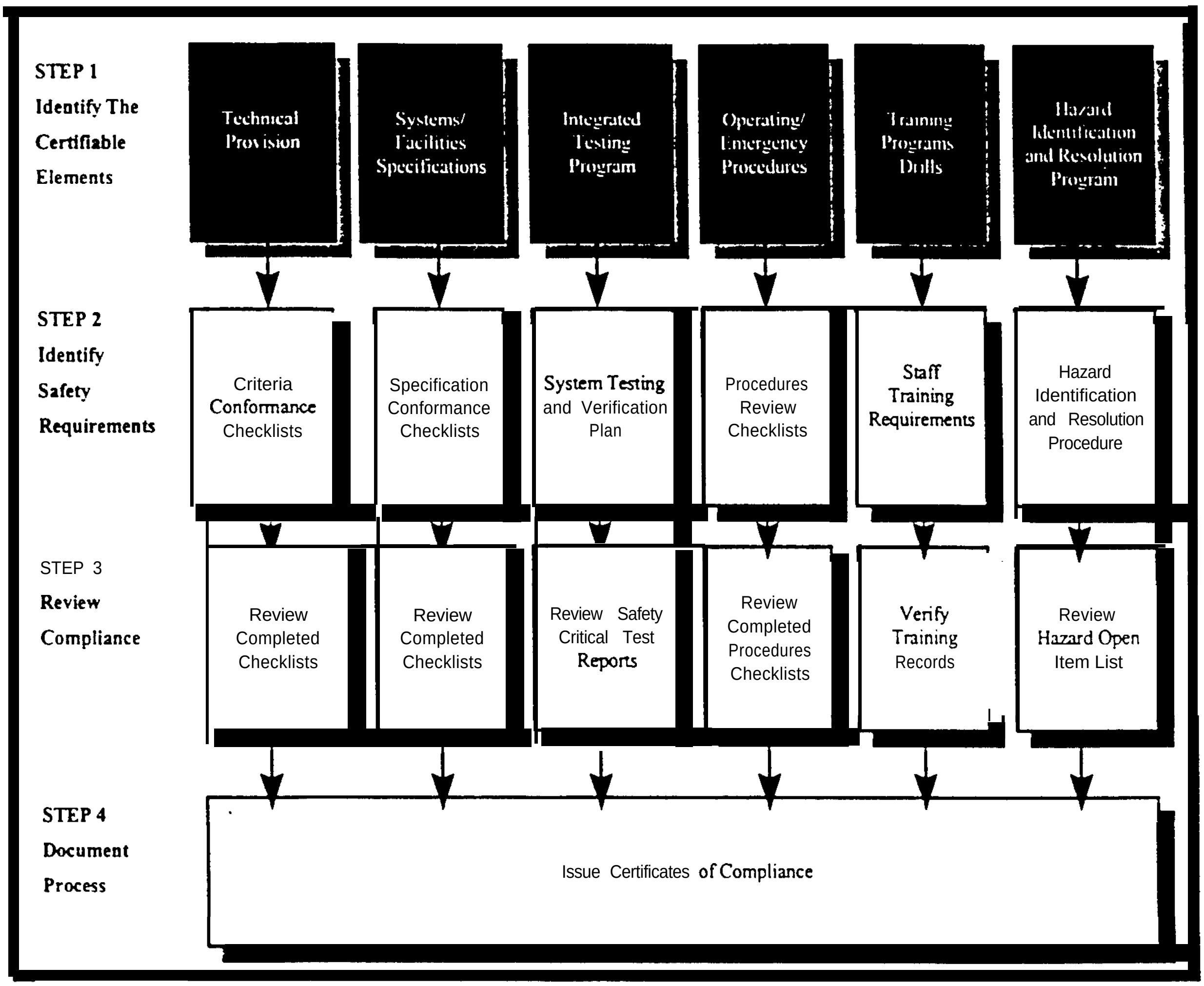


Exhibit 2-2 - Preliminary List of Certifiable Elements

SYSTEMS EQUIPMENT	FIXED FACILITIES
• LRT Car • Signaling/Train Control • Communications • Fire Protection and Suppression Systems • Grade-crossing equipment	• Control Center • Yard and Shop • Station Stops • Bridge Rehabilitation and/or New Bridge • Trackwork
SAFETY RELATED PLANS & PROCEDURES	**TRAINING PROGRAMS**
• Hazard Resolution & identification Procedure • System Safety Program Plan • Operating Rules and Procedures • Emergency/Disaster Response Procedures • Operators' Rule Book • Operations & Maintenance Plan • System Testing and Verification Plan • Accident/Incident Investigation & Reporting Procedure	• LRT Car Operator's Training Program • Control Center Personnel Training • Yard Personnel Training • Maintenance Personnel Training • Emergency Services Training • On-going Refresher Training

During the final design processes, Criteria Conformance Checklists will be developed for each of the system and fixed facility certifiable elements. The checklists will be developed by the Contractor based on **Book V: Technical Provisions.** All checklists will be approved for completeness, accuracy and content by NJ Transit. A sample page from a typical Criteria Conformance Checklist is shown in Exhibit 2-3.

2.2.1 Criteria Conformance Checklist Compliance Reviews

During the final design process, NJ Transit will use the Criteria Conformance Checklists to verify that all applicable design requirements, as identified in the Technical Provisions, have been incorporated into the appropriate system and facilities specifications.

The Safety Committee will have the responsibility to review evidence (i.e., completed checklists) that the specifications conform with the design requirements. The evidence should demonstrate proper incorporation of the safety, fire/life safety and security into the appropriate contract specifications. Any discrepancies between the requirements and specifications relating to safety must either be corrected, or approved by the Safety Committee.

2.2.2 Criteria Conformance Certification

When the Safety Committee determines that all safety, fire/life safety and security criteria are properly reflected in the Contract specifications for a certifiable element, the Safety Committee will recommend that the element receive a “Criteria Conformance Certificate.” The certificate will confirm that the specifications properly reflect, and conform to the mandatory requirements of the Technical Provisions. If, upon review by the Safety Committee, the specification language and/or drawings do not comply with the intent of the Technical Provisions, the Safety Committee has the authority to withhold its recommendation that the element receive a Criteria Conformance Certificate. A representative example of a Criteria Conformance Certificate is shown in Exhibit 2-4.

2.3 SPECIFICATION CONFORMANCE CHECKLISTS

The Contractor will prepare a Specification Conformance Checklist to identify the safety, fire/life safety and security requirements included in each specification. During supplier design reviews, audits, inspections and tests, the Contractor will use the checklists as a tool to identify, collect, and document the approval of evidence that demonstrates safety requirements have been achieved.

A suggested format for the Specification Conformance Checklist is shown in. Exhibit 2-5. The Contractor is responsible for developing the Specification Conformance Checklists. The checklists will be updated as required when subsequent approved engineering changes affect safety, fire/life safety, or security. All checklists will be approved for completeness, accuracy and content by NJ Transit.

2.3.1 Specification Conformance Checklist Compliance Reviews

Each safety, fire/life safety and security requirement contained in the Specification Conformance Checklists will require evidence that demonstrates its achievement. Some requirements such as hazard analyses, test plans and manuals are Contract deliverables. There are other safety requirements that will not be met with a formal submittal, but will need to be verified by other means to assure the best possible safety of the system. Compliance with these requirements will need to be verified by DBOM Contractor personnel during design reviews, audits, inspections and tests. Collecting the written evidence for compliance will rest with the Contractor. NJ Transit and the Safety Committee must approve any discrepancies between end products and specifications that are safety-related.

Exhibit 2-3 - SAMPLE CRITERIA CONFORMANCE CHECKLIST

CRITERIA CONFORMANCE CHECKLIST

NJ TRANSIT
SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

SAFETY CERTIFICATION PROGRAM

GROUP:______________________ **DATE:**______________
REVIEWER:______________________
SPECIFICATION NAME:______________ **SPECIFICATION NO.**________
CRITERIA SECTION:______________ **REVIEW LEVEL:**__________

I.D.	REQUIREMENT	SPECIFICATION REF.
2.6.4	An emergency release lever shall be provided for each doorway on the inside and at least one per side on the outside of an LRT Car.	Book V: Technical Provisions
2.6.5	A door lock mechanism shall be provided to positively retain the doors in the closed position.	Book V: Technical Provisions
5.4	The maintenance facility of the LRT system shall be provided with fire and intrusion alarm systems.	Book V: Technical Provisions (Part B)
3.4.2.1	Ramps -The size and location of ramps shall satisfy platform access and egress requirements, meet all applicable codes, including the requirements ‘of the ADA.	Book V: Technical Provisions (Part B)

Exhibit 2-4 - Sample Criteria Conformance Certificate

CRITERIA CONFORMANCE CERTIFICATE

NJ TRANSIT
SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

SAFETY CERTIFICATION PROGRAM

Completion of this Certificate indicates that the specifications and drawings of the Certifiable Element indicated below comply with all applicable safety, fire/life safety and security design criteria.

CERTIFIABLE ELEMENT: ____

CONTRACT SPECIFICATION(S) INCLUDED:

-
-
-
-

EXCEPTIONS NOTED:

Chairperson, Safety Committee Contractor	Date	Project Director NJ Transit	Date

2.3.2 Specification Conformance Certification

The Safety Committee will review evidence that the safety, fire/life safety and security requirements of the specification have been achieved. The Safety Committee is responsible for reviewing the evidence and recommending to NJ Transit management that a certifiable element is safe for public use and should receive a Certificate of Compliance. An example format for the certificate is shown in Exhibit 2-6.

2.4 SYSTEM TESTING AND VERIFICATION PROGRAM

In accomplishing safety certification, the ability for the various elements of the SNJLRTS (facilities, equipment and procedures) to function together as an integrated system, and do so in a safe manner, must be demonstrated. Accordingly, an important aspect of certification should be accomplished during integrated system testing and start-up is to:

- verify the compatibility of equipment, facilities and operating procedures to function together under normal, adverse and emergency situations
- verify the coordination and response capabilities of NJ Transit and outside agencies
- identify equipment, facilities, software, and operating procedures that must be modified to achieve a reasonable degree of safety and satisfy operational requirements

To affirm that management and technical resources are applied in an organized fashion, a Svstem Testing and Verification Plan (STVP) must be developed by the Contractor. As such, one of the certifiable elements will be the STVP itself. The STVP will be prepared during the construction phase of the SNJLRTS Project, covering all inspection and testing activities from delivery and acceptance of facilities and equipment, up to the start of revenue service. The STVP will cover both functional and safety testing. Safety-related tests will be identified in the STVP and become certification requirements.

The organization responsible for performing system verification and tests will provide evidence to the Safety Committee that all safety-related inspections and tests in the STVP have been accomplished.

As each test is successfully completed, the Safety Committee will issue a Certificate of Compliance similar to that shown in Exhibit 2-6.

Exhibit 2-5 - Sample Specification Conformance Checklist

Contract:

SPECIFICATION CONFORMANCE CHECKLIST

Revision

Date:

Prepared By ____________

DBOM Contractor Staff

NJ TRANSIT

Approved By ____________

Contract No.

SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

Chairperson, Safety Committee

DBOM Contractor

Page: _ of _

SAFETY CERTIFICATION PROGRAM

Approved By ____________

Project Director, NJ Transit SNJLRTS

Item	Safety Requirement	Specification Reference		Method of Verification	EVIDENCE			
		Section-Page	Paragraph		Title of Verification Document	Approval Document File Number	File Verified By	File Verified Date
1	Operator cab doors shall be lockable from inside and outside	9-1	9.1b	Test				
2	The cab layout shall provide adequate visibility for the operator to the station platform and LRT Car interior for control of the train and safety of the passengers	9-2	9.4	Inspection Test				
3	The operator cab shall include, as a minimum, the following: - Fire Extinguisher - Parking Brake Control - Communication6 Control Unit - Manual Controller with "Deadman" feature	9-3	9.5.1	Inspection				
4	The surface area of the console shall be non-reflective	9-4		Test				

Exhibit 2-6 - Sample Specification Conformance Certificate

SPECIFICATION CONFORMANCE CERTIFICATE

NJ TRANSIT
SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

SAFETY CERTIFICATION PROGRAM

Completion of this Certificate indicates that the Certifiable Element shown below complies with all applicable specifications of safety, fire/life safety and security requirements and is judged safe for public use in revenue service.

CERTIFIABLE ELEMENT: ______________________________

DATE OF CERTIFICATION: ______________________________

RESTRICTIONS:

______________________________ ______________________________

Chairperson, Safety Committee Contractor	Date	Project Director NJ Transit	Date

2.5 PROCEDURES

A formal "Operating and Maintenance Procedure Review Cycle" will be established by the Contractor to review procedures, manuals, and documents relevant to the operation of the SNJLRTS, as they become available prior to revenue service. This review cycle enables comments to be provided by engineering, safety, transit police, operations, and maintenance personnel.

To document the review of procedures, a Procedure Review Checklist will be used. A representative example of a Procedure Review Checklist is illustrated in Exhibit 2-7. Upon completion, the organization(s) responsible for developing safety-related plans and procedures will provide evidence of approval to the Safety Committee, who will then issue a Certificate of Compliance similar. to that shown in Exhibit 2-6.

Exhibit 2-7 - Procedure Review Checklist

PROCECURE REVIEW CHECKLIST

NJ TRANSIT
SOUTHERN NEW JERSEY LIGHT RAIL TRAINSIT SYSTEM

SAFETY CERTIFICATION PROGRAM

OCUMENT TITLE: ______________________ DATE OUT: . ____________

OCUMENT REVISION: ______________________ DATE DUE: ____________

RESPONSIBLE DEPARTMENT/SECTION: ______________________

ERTIFIABLE ELEMENT: ______________________

REVIEW RESPONSIBILITY	REVIEWED BY:	COMMENTS RECEIVED (DATE)	DISPOSITION		
			ACCEPT	NOT ACCEPTED	ACCEPT W/ CHANGES
NJ Transit					
Contractor					
Police Department					
Fire Department					
Others					

2.6 OPERATIONS AND MAINTENANCE TRAINING

The Contractor and NJ Transit will identify operations and maintenance training programs and drills that affect safety. Operations and maintenance staff will successfully complete all safety-related training programs, as required. The Contractor will provide a uniform methodology for:

- identifying safety-related training programs
- verifying that all safety-related training programs are successfully completed by appropriate staff

A Training Conformance Certificate will be provided to document the successful delivery of training programs. A representative example of a Training Conformance Certificate is shown in Exhibit 2-8.

The procedure for issuing a Training Conformance Certificate for operations and maintenance training should be as follows:

- upon completion of each training program, a Training Conformance Certificate is filled out by the instructor. At the discretion of the instructor, all attendees who have successfully completed the training can sign the form. (Signatures are optional, but encouraged.)

- the completed training form(s) is submitted to the Safety Committee who determines that evidence of a successfully completed training program is available. The Conformance Certificate is prepared and is signed by the Training Instructor, Safety Committee Chairperson and the NJ Transit Director.

2.7 HAZARD IDENTIFICATION AND RESOLUTION

A formal Hazard Identification and Resolution Procedure will be developed to ensure that potential hazards are systematically identified, evaluated, and resolved during SNJLRTS design, construction, testing, and revenue operations. Hazard identification and subsequent resolution are based on information from:

- design reviews where representatives of safety, security, and operations participate

- hazard analyses and special reports

- information from other transit systems

- observations and experiences of program participants during construction and testing.

During preliminary engineering, the hazard identification and resolution process is guided by the preparation of a Preliminary Hazard List (PHL), completed by the GDAC. Prior to final design, the Contractor will expand the hazard identification and resolution process to include Failure Modes and Effects Analysis (FMEA) and Operating Hazard Analysis (OHA). A formal procedure will be prepared to document:

- hazard analyses review and approval procedures

- guidelines and approval processes for closing identified hazards

Exhibit 2-8 - Sample Training Conformance Certificate

TRAINING CONFORMANCE CERTIFICATE

NJ TRANSIT
SOUTHERN NEW JERSEY LIGHT RAIL TRANSIT SYSTEM

SAFETY CERTIFICATION PROGRAM

Completion of this Certificate indicates that the personnel listed below have successfully completed an approved training program for the indicated subject matter.

SUBJECT MATTER: ____________________

	Name	Signature
1.	________	________
2.	________	________
3.	________	________
4.	________	________
5.	________	________
6.	________	________
7.	________	________
6.	________	________
9.	________	________
10.	________	________

____
Training Instructor Date

______________________ ______________________
Chairperson, Safety Committee Date | Project Director Date
Contractor | NJ Transit

- A means for all NJT, GDAC, and the Contractor to identify potential hazards which are observed during construction, testing, or operations.

Prior to revenue operations, the Safety Committee will review evidence that all identified hazards have been formally closed (i.e., hazards have been mitigated to the largest extent possible). Upon satisfactory completion of the review, a Certificate of Compliance similar to that shown in Exhibit 2-6 will be issued.

At the completion of the certification process, the Contractor will retain all certificates, and present as a complete set to NJT and NJDOT prior to the start of, and as a basis for revenue service.

3.0 Certification Task Schedule

The entire safety certification process requires specific tasks to be accomplished as the SNJLRTS progresses from preliminary engineering through start-up operations. To appropriately plan for the certification process it is necessary to link the tasks to a milestone schedule. The safety certification work effort, expressed in a series of tasks with a corresponding milestone schedule, is shown in Exhibit 3-1.

Exhibit 3-1 - Task Schedule for Safety Certification

Task	Schedule	Responsibility
Criteria Conformance Checklists		
Prepare Checklists	Preliminary Engineering	GDAC
Verify Checklists	Pre-Final Design	Safety Committee
Issue Certificates	Final Design	Safety Committee
Specification Conformance Checklists		
Prepare Checklists	Final Design	Contractor
Verify Checklists	Construction/Testing	Contractor
Issue Certificates	ntegration Testing	Safety Committee
Integrated Testina Program		
Prepare System Testing and Verification Plan	Final Design	Contractor
Review Safety Critical Test Reports	Integrated Testing	Safety Committee
Issue Certificates	Integrated Testing	Safety Committee
Operating/Emergency Procedures		
Prepare Procedures Review Checklists	Construction/Testing	Contractor
Review Completed Checklists	Integrated Testing	Safety Committee
Issue Certificates	Integrated Testing	Safety Committee
Training Programs/Drills		
Identify Staff Training Requirements	Construction/Testing	Contractor
Verify Training Requirements	Integrated Testing	Safety Committee
Issue Certificates	Pre-Revenue Operations	Safety Committee
Hazard Identification and Resolution		
Prepare Hazard Identification and Resolution Procedure	90 Days After NTP	Contractor
Review Safety Opens Items List	Integrated Testing -	Safety Committee
Issue Certificates	Integrated Testing	Safety Committee

APPENDIX C - PRELIMINARY HAZARD LIST (PHL)

APPENDIX C -TABLE OF CONTENTS

1 Preliminary Hazard List (PHL)

1.0 Purpose

This Preliminary Hazard List (PHL) has been prepared for the Southern New Jersey Light Rail Transit System (SNJLRTS) to identify, and systematically assess conditions which could potentially affect the safe operation of the system. The purpose of the PHL is to:

- Identify hazardous conditions, which could exist; evaluate the effects of the hazards to personnel and equipment; and define conceptual designs and criteria to eliminate, or control the identified hazards
- Document the safety concepts incorporated during system development, and provide the basis for developing procedures
- Provides a checklist for guiding the Preliminary Design Review (PDR) and the Final Design Review (FDR)
- Provides a basis for requiring more detailed safety analyses for specific project elements and subsystems.

2.0 Scope

The PHL addresses the following elements of the SNJLRTS:

- Alignment (Right-of-Way)
- Station Stops
- Yard & Shop Facilities
- LRT Cars
- LRT Car Controls and Operator Interface
- Signaling
- Communications
- EMI/EMC/RFI
- Track Maintenance
- System-wide.

The PHL is valid for the conceptual designs for the project. During final design, the DBOM Contractor will update the PHL. Although the PHL will provide a useful checklist for guiding PDRs, and FDRs, formal verification that the identified hazards are closed will occur in the subsequent safety analyses and during the Safety Certification Program.[1] Once the more detailed safety analyses begin, the PHL will no longer be updated.

3.0 Methodology

The PHL consists of:

- Hazard identification

[1] *Southern New Jersey Light Rail Transit System, Safety Certification Plan, Revision 3, January 8, 1998*

- Hazard assessment
- Hazard resolution.

The methods used for identifying hazards contained in this PHL included examining the design and operational concepts defined in the SNJLRTS preliminary engineering specifications and drawings, and examining historical information and data from similar transit systems. Where references are made to operating procedures, rules, etc., they are based on current industry practices, which will need to be fully implemented or tailored for use on this project.

Because the PHL is preliminary in nature, and serves to establish early priorities for corrective action of identified hazards, the hazard assessment is based primarily on the severity of the hazard, and its probability of occurrence. Upon completion of the final subsystem and system designs by the DBOM Contractor, these two measures should be reevaluated.

To resolve the identified hazards, the following order of precedence is established:

- Eliminate the existing hazard if possible.
- Design for minimum hazard.
- Utilize safety devices.
- Utilize warning devices.
- Implement procedures and training.

4.0 Format

The format of the PHL worksheets is as follows:

<u>System Element</u>	A major functional element of the transit system.
<u>Hazard Number</u>	A unique hazard scenario identifier which is used for tracking purposes.
<u>Hazard Scenario Description</u>	A potential hazardous condition that exists, including potential causes.
<u>Effect on Personnel/Transit System</u>	The safety effects, both minor and major resulting from the hazard.
<u>Hazard Severity</u>	Qualitative measure of the worst potential consequence resulting

from the hazard. (Refer to Table 1)

Hazard Probability — Qualitative measure of the hazard occurring during the planned life of the system. (Refer to Table 2)

Possible Controlling Measures and Remarks — Actions that can be taken or procedural changes that can be made to prevent the anticipated hazardous event from occurring.

Resolution (Next Action) — Measures taken to demonstrate an adequate level of safety can be achieved (i.e. functional verification tests, procedure validation).

Reference: MIL-STD-882C, System Safety Program Requirements

TABLE 1. HAZARD SEVERITY CATEGORIES

Description	C	Definition
CATASTROPHIC	I	Death, system loss, or severe environmental damage.
CRITICAL	II	Severe injury, severe occupational illness, or minor system or environmental damage.
MARGINAL	III	Minor injury, minor occupational illness, or less than minor system or environmental damage.
NEGLIGIBLE	IV	Less than minor injury, occupational illness, or less than minor system or environmental damage.

TABLE 2. HAZARD PROBABILITY LEVELS

Description		L Specific	Fleet or
FREQUENT	A	Likely to occur frequently	Continuously experienced
PROBABLE	B	Will occur several times in the life of an item	Will occur frequently
OCCASIONAL	C	Likely to occur some time in the life of an item	Will occur several times
REMOTE	D	Unlikely, but possible to occur in the life of an item	Unlikely, but can reasonably be expected to occur
IMPROBABLE	E	So unlikely, it can be assumed occurrence may not be experienced	Unlikely to occur, but possible

5.0 PHL Worksheets

The following pages present the PHL worksheets.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________ Date: ____________
Reviewed by: ____________ Date: ____________
Approved by: ____________ Date: ____________

System Element: Alignment

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	[illegible] Resolution
ALGN-3	Intrusion of toxic or flammable gases into alignment area due to HAZMAT gas accident occurring in adjacent freight operations, buildings in the alignment proximity, underground pipeline rupture, or motor vehicle accident.	Potential for serious injury/ death to passengers/employees as a result of contaminated air and possible fire. Emergency evacuation is required. Service interruption.	I / D	Establish procedures for proper train operations during these conditions. Establish procedures for Control Center coordination. Establish plan for local emergency response coordination.	Verify that controlling measures are included in Operating Procedures and establish coordination meetings, drill exercises and regular correspondence with local emergency response agencies.
4LGN-4	Intrusion of unauthorized person(s) onto the alignment due to absence of proper barriers, signage, etc., or disregard thereof.	Potential for severe injury/death to person/s if struck by LRT Car/s. Service interruption.	II / C	Alignment areas will be fenced where deemed appropriate (i.e. schools, playgrounds). Remote areas of the alignment, or those inaccessible to the public will not be fenced. Track separation fences are being considered for specific station stop areas. Implement public outreach programs to enhance awareness of light rail traffic in local communities.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by:	Date:
Reviewed by:	Date:
Approved by:	Date:

System Element: Alignment

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
ALGN-5	Collision with passenger vehicle due to equipment failure. Collision with bus or tanker due to equipment failure. Collision with passenger vehicle due to intentional drive-around.	Potential for severe injury/multiple deaths in LRT Car/motor vehicle collision. Possible LRT Car/s derailment. Track and alignment damage. System-wide service cessation.	II / D I / D II / D	At-grade crossings will be protected by warning devices, and traffic control signals. Speed limits for the street running sections of the LRT will be consistent with posted speed limits for motor vehicle traffic. At-grade crossing LRT speeds are dependent on operator line-of-sight of a clear crossing and confirmation of a locked barrier and operational warning devices.	Implement a Grade Crossing Protection Plan. Achieve NJ DOT certification for grade crossing installations. LRT Car will use audible warning devices upon approach per FRA ruling.
ALGN-6	Collapse of track/bridges due to structural deficiencies, adjacentexcavation, excessive static or dynamic loads.	Potential for severe injury/multiple deaths. Possible LRT Car/s derailment. Track and alignment damage. System-wide service cessation.	I / E	Implement/verify correct specifications used for track, ballast and bridge structures are consistent with expected freight and LRT train loads (bridge loading rating analysis and bridge condition report performed). Perform periodic inspection and maintenance. Establish corrosion control plan and procedure for bridge surfaces.	Verify controlling measures during PDR, and FDR and in maintenance procedures.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Alignment

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
ALGN-7	Collapse or washout of alignment due to flooding, gradual soil erosion, or embankment collapse.	Potential for severe injury/multiple deaths. Possible LRT Car/s derailment. Track and alignment damage. System-wide service cessation.	I / E	Perform periodic inspection and maintenance of culverts, etc. Proposed alignment will be surveyed and mapped. Areas susceptible to soil erosion or collapse will be identified, and measures will be taken to protect the alignment in these locations.	Verify controlling measures during PDR, and FDR, and in maintenance procedures.
ALGN-8	Encroachment of freight vehicle due to improper operation, or derailment.	Potential for severe injury/multiple deaths. Possible LRT Car/s derailment. Track and alignment damage. Service interruption.	I / D	All passing sidings, freight sidings, and freight spurs will be signalized. Local signal control and Central Control signal control is required. The proposed mode of operation requires that all freight operations occur at night at the completion of SNJLRTS service (i.e. time separation). Encroachment detection required at railroad junctions/freight spurs, with derails fitted.	Verify controlling measures during PDR and FDR, and in Operating Procedures. Perform periodic audit of freight operations.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Alignment

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
ALGN-9	Foreign object on track or in vicinity of alignment due to lost LRT Car equipment, nearby construction, vandalism, or natural forces.	Potential for severe injury/multiple deaths. Possible LRT Car/s derailment. Track and alignment damage. Service interruption.	I / D	Hazard severity dependent on object obstructing train path. Reduce risk by implementing operational procedures. (e.g. First train out reports, operator vigilance, wayside inspection).	Verify that controlling measures are in Operating Procedures. Verify that security program adequately addresses noted vandalism.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by:		Date:	
Reviewed by:		Date:	
Approved by:		Date:	

System Element: Station Stops

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
STAT- 1	Fire/smoke on station stop platforms due to electrical wiring faults, ignition of flammable gas/liquid, or vandalism.	Potential for injury/death to patrons. Station-stop damage/loss. Service interruption.	II I D	Station stop electrical design will utilize NEC. and UL criteria as applicable. Periodic inspection and maintenance of station stop electrical facilities will be performed. Patrons will not be permitted to carry flammable substances on trains and will be advised of this via on-board, and platform signage. Platforms will be designed in accordance with the required NJ State Fire Code for such structures. Proper signage will be posted on platforms for exiting. Emergency 911 access will be provided at designated locations on all platforms. Enclosed intermodal stations will be protected by automatic fire sprinkler systems in compliance with NFPA 130.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Station Stops

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario / Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
STAT-2	Intrusion of toxic/flammable gases into station stop area due to natural gas accident near station stop.	Potential for injury to passengers on incoming or departing trains, and patrons on platform.	II / D	Provide procedures that address train operations during emergencies in the proximity of the alignment. Flammable or hazardous liquid or gas lines crossing the right-of-way, except when located in public roadways shall comply with the NJ Uniform Fire Code.	
STAT-4	Platform/LRT Car gap is too large, due to inadequate station design, LRT Car load leveling control failures, or use of platforms that accommodate passage of freight railcars.	Potential for injury to patrons with special needs (i.e. wheelchair access; visually impaired; children strollers, walking aids).	II / D	Ensure platform to car distance is ≤ 3in. per ADA requirements for all platforms. The LRT Car will utilize its retractable step plate accommodation at some platforms. LRT Car load-leveling systems will be designed to be fail-safe, with secondary metal springs that support the car body should the air spring or compressed air supply fail.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Station Stops

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/Probability	Possible Controlling Measures and Remarks	Resolution
STAT-5	Vandalism during non-operating hours due to inadequate security.	Potential for minor injuries to patrons due to vandalism of station property.	III / c	Stations will not be designed to include gates/fences, however features that enhance security (e.g. appropriate lighting, landscaping) will be implemented. Security patrol considerations are currently in process to determine shared responsibilities between the Contractor and NJTPD.	Verify during PDR and FDR. Verify System Security Plan adequately addresses hazard.
STAT-6	Criminal acts against patrons and employees (i.e. robbery, assault, etc.)	Potential for injury to patrons and/or employees due to force used in criminal act. Potential for decrease in rider-ship.	II I D	Implement security plan to protect patrons, employees, and SNJLRTS equipment. Utilize Crime Analysis results as approprigte to shape security strategies.	A Security Program Plan for SNJLRTS has been prepared to identify the roles and responsibilities of law enforcement agencies assigned to the system. Additionally, a crime analysis was performed for the cities/towns along the alignment. The results of this analysis established a baseline from which future comparisons can be drawn regarding crimes occurring after the service becomes operational.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Station Stops

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
STAT-7	Improperly insulated, ineffective grounding, or exposed electrical wiring.	Severe injury to patron/ employee may result due to contact with exposed wiring, or charged electrical element.	II I D	Approved state building codes and national electrical safety codes/guidelines will be used in the construction and outfitting of station stops. Wire runs will be located and guarded to prevent accidental contact by patrons.	Verify during PDR and FDR.
STAT-8	Loss of electrical insulation, grounding potential, or exposed electrical wiring due to vandalism. (e.g. TVMs)	Severe injury/death to patron/employee may result due to potential contact with exposed wiring.	II I D	Perform periodic inspections and preventive maintenance. Maximize use of vandal resistant materials, and equipment. Electrical runs will be protected via metal conduits. Enhance security patrols at stations where vandalism is prevalent.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________ Date: ______
Reviewed by: ____________ Date: ______
Approved by: ____________ Date: ______

System Element: Station Stops

Hazard Severity:
I Catastrophic   II Critical
III Marginal   IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
STAT-9	Obstacles with sharp protruding edges in, or adjacent to station walkways due to lack of maintenance or vandalism.	Minor injuries to patrons may result if contact is made with sharp edges of station fixtures and equipment.	III / D	Perform periodic inspections of station stop facilities. Maximize the use of human factors design criteria in station layout.	Verify during PDR and FDR, and during initial and scheduled station inspections.
STAT-10	Inability for visually impaired patrons to discern platform edge resulting in falls from station stop platforms.	Potential for serious injury/death if patrons fall in path of oncoming train.	II / D	Platform edges will have a distinctive surface characteristic from the rest of the platform. Maximum platform height will be 24 in. Platform edges will be painted with highly visible paint or use a high visibility material, and . will be marked to avoid patrons assembling near them. Train approach speeds to platforms will be identified in operations manuals.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________ Date: ________
Reviewed by: ____________ Date: ________
Approved by: ____________ Date: ________

System Element: Station Stops

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	[illegible] Resolution
STAT-11	Slippery station surfaces or uneven platform surfaces.	Potential for injuries to patron and/or employees due to falls on platform or entrances/exits.	III / c	Walking surfaces will have slip resistance surfaces and proper drainage to prevent puddling. Utilize industry best practices in station construction design, and conduct repair of damaged platform surfaces as soon as possible following identification. During maintenance/cleaning activities, signage to indicate that activity will be posted.	Verify during PDR and FDR and in maintenance procedures.
STAT-12	Pedestrian/motor vehicle accidents during pick-up and drop-off at station stops (i.e. kiss-n-ride, park-n-ride)	Potential for injury/death to patron. No impact to service. Potential for legal actions with local municipality and owner/operator.	II ID	Provide stations stops with marked pedestrian crossings, entrance/exit and motor vehicle right-of-way signage.	Apply sound traffic engineering principles to enhance safe traffic and pedestrian flow.

Southern New Jersey Light Rail Transit System Preliminary Hazards List	 Prepared by: ______ Date: ______ Reviewed by: ______ Date: ______ Approved by: ______ Date: ______
System Element: Station-Stops	**Hazard Severity:** I Catastrophic II Critical III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/Probability	Possible Controlling Measures and Remarks	Resolution
STAT-I 3	Platform overcrowding due to unusually large ridership levels from special events, or disruptions of other transportation modes.	Possible falls in front of approaching LRT Car resulting in serious injury/death.	II / c	Train frequencies/capacities scheduled for peak and off-peak conditions. A 15 min. headway is established for operating periods (6 a.m.-9 a.m.), and (5 p.m.-7 p.m.), Monday to Friday. At all other times, a 30 min. headway will be observed. A specific headway will be established for special events. Provide ample queuing areas adjacent to station stops serving entertainment centers.	Verify in "Special Train" and Emergency Procedures, and during PDR and FDR.

Southern New Jersey Light Rail Transit System Preliminary Hazards List	Page: 13 of 43
	Prepared by: ____ Date: ____
	Reviewed by: ____ Date: ____
	Approved by: ____ Date: ____
System Element: Yard/Shop facilities	**Hazard Severity:** I Catastrophic; II Critical; III Marginal; IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
YSF-1	Fire/smoke in yard and shop maintenance facilities.	Potential for serious injury/death to maintenance personnel.	II / D	Apply NJ state and local building safety codes in facility design. Implement NFPA 10, requiring installation of portable fire extinguishers, tire and smoke sensors in maintenance facilities. Provide adequate electrical circuit protection in accordance with NEC criteria.	Verify during PDR and FDR.
YSF-2	Improper handling of shop materials due to ineffective procedures, poor documentation, inadequate training, lack of safety equipment or compliance with.	Potential for serious injury to maintenance personnel. Damage to equipment/ materials.	II / D	Procedures and training will be developed by the Contractor to address proper use of tools, equipment, etc. during maintenance activities. Safety identifiers will be contained in maintenance procedures to ensure personnel are continuously aware of potential hazards. Require compliance with all OSHA standards.	Verify OSHA standards during PDR and FDR. Operating Hazard Analysis (OHA) is required for all maintenance facilities.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ________ Date: ________
Reviewed by: ________ Date: ________
Approved by: ________ Date: ________

System Element: Yard/Shop Facilities

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
YSF-3	Unauthorized intrusion into yard areas due to inadequate security.	Potential for system degradation/accident occurring due to intruders acts (leaving foreign object on rail, vandalizing switches or equipment). Injury to intruder/s requiring assistance and removal by operations personnel.	II / C	Provisions will be made to secure maintenance facilities via non-scalable barriers. A clear zone (20 ft from the barrier) will be maintained to preclude concealment of intruders. Gates will be provided for access to the yard facilities. 24-hour security will be required for these facilities.	Verify adequate security measures in System Security Plan, and during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____ Date: ____
Reviewed by: ____ Date: ____
Approved by: ____ Date: ____

System Element: Yard/Shop Facilities

Hazard Severity:
I Catastrophic — II Critical
II Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
YSF-4	Improper storage/handling of toxic or flammable substances due to absence of proper storage areas, lack of policy, procedures, or training regarding storage and handling of toxic or flammable substance.	Potential for severe injury/death to maintenance personnel resulting from yard area explosion, toxic vapor or substance exposure. Yard facility damage, and contamination. Potential for HAZMAT cleanup.	I / D	Implement the NJ Uniform Construction Code to address structure, plumbing and electrical requirements for combustible liquids storage/ handling. Fuel storage tank should have spill containment provisions capable of holding 110% of tank's capacity. Implement spill prevention/ control plan. Provisions will be made for emergency access within the yard, and shop areas. Maintenance areas will be equipped with the appropriate fir suppression systems.	Verify during PDR and FDR and in maintenance, emergency, delivery, and storage procedures. OHA required.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____ Date: ____
Reviewed by: ____ Date: ____
Approved by: ____ Date: ____

System Element: Yard/Shop Facilities

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
YSF-5	Unsafe train movements in yard.	Potential for operator injury/death in train collisions. Potential for derailment and/or trains striking yard personnel. Property damage.	I / D	All train movements within the yard are restricted to 10 mph. Yard switches will be provided with switch indicators. Provide initial training and operations support training programs for yard personnel. Institute procedures, advisory signage, adequate lighting, etc., to enable safe train operations in yard.	Verify during PDR and FDR and in Maintenance Procedures.
YSF-7	Machine shop accidents due to nature of work performed [i.e. rotating devices, cutting tools, tool breakage, etc.)	Potential for injury/loss of limbs to maintenance shop personnel.	I / D	Implement employee safety program for shop operations. Provide emergency first-aid kits in designated points within shop. Establish lines of communication for injuries requiring evacuation. Utilize protective shields on rotating equipment. Protective clothing, face shields, hard hats, goggles will be used as required.	Verify in shop procedures. OHA required.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Yard/Shop Facilities

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
YSF-8	Battery cell rupture and release of contaminants due to overcharging or improper use in service and storage areas.	Potential for chemical burn injury to shop personnel. Contaminated shop area.	II / D	Implement battery-charging procedure, which contain the necessary safety instructions to follow during charging operations. Identify hazard potential to shop personnel via Material Safety Data Sheets (MSDS) for battery electrolyte. Implement battery disposal procedure. Provide emergency eyewash stations.	Verify in PDR, FDR, Shop Procedures and System Safety Program Plan.
(SF-9	Falling in maintenance pit and accidental contact with heavy machinery.	Potential for blunt trauma injury/death to maintenance personnel.	II / D	Warning signs, devices, and/or barriers will be provided in maintenance pit areas. Heavy equipment will be secured and stabilized when not in use. Implement employee safety . program as required by OSHA.	Verify in PDR, FDR. Shop Procedures and SSPP. OHA required.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: LRT Cars

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
LRT-1	LRT Car fire/smoke due to equipment failure (i.e. auxiliary electrical equipment, battery short circuit, overheating of drive mechanisms).	Potential for injuries/death to passengers. Emergency evacuation is required. Service interruption/revenue loss. Removal of LRT Car from service.	I ID	An over temperature sensor is provided to trip a battery circuit breaker in cases where a failure may cause overcharging. LRT Car floors will be designed to serve as a fire barrier from external ignition sources. Fire extinguishers will be in each LRT Car operator's cab. Car interior materials carry flammability ratings.	Verify during PDR and FDR. OHA and Failure Mode, Effects Analysis (FMEA) required.
-RT-2	Protrusion/sharp edges on interior surfaces due to inadequate machining tolerances.	Minor injury may result if passengers or employees contact sharp edges or protrusions.	III / c	Inspect LRT Car/s in accordance with established Quality Control procedures at manufacturer prior to delivery. Perform periodic in-service inspection and maintenance.	Verity inclusion in manufacturer inspection checklist and in periodic maintenance checklist

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: LRT Cars

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
LRT-3	Inadvertent opening of LRT Car doors during train movement.	Potential for severe injury/death to passenger/s falling from car. Service interruption.	II / E	LRT Cars will contain door/propulsion power interlock mechanisms to prevent train movement while doors are open, and prevent door opening while the train is in motion. If the doors are forced open, or manually released, a full service brake application will be applied. Door interlock status will be provided to the operator.	Verify during PDR and FDR. OHA and Failure Mode, Effects Analysis (FMEA) required.
-RT-4	Unauthorized use of safety critical bypass switches.	Potential for severe injury/death to passengers and employees resulting from train collision or derailment. Service interruption.	III / B	Operating procedures require that the LRT Car operator, prior to each shift, ensure that safety critical bypass switches are properly configured. Install sealed switches to control unauthorized use of bypass switches.	Verify enforcement of strict administrative controls. Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: LRT Prop/Braking Control

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
PRPBK-1	Inadequate/loss of braking forces due to failure/malfunction of brake system equipment.	Potential for serious injury/death to passengers and employees due to collision and derailment following loss of braking control. Service interruption/cessation.	I / D	The LRT Car friction braking system will be designed to be fail-safe, both electrically and mechanically. The system includes a parking brake, track brake, and sand ejectors. Wheel-mounted disc brakes and propulsion dynamic braking systems will be used. The operator is also provided with a cab-mounted signal to indicate loss of brake line pressure.	The Contractor shall request from the Manufacturer all brake test data and certification report upon delivery of first LRT Car. OHA and FMEA required. Verify during PDR and FDR.
PRPBK-2	nadequate/loss of braking forces due to lack of adhesion, or brake thermal overload.	Potential for serious injury/death to passengers and employees due to collision and derailment following loss of braking control. Service interruption/cessation.	I / D	The LRT Car brake system includes load-weighing compensation, and slide protection to ensure a constant braking force, and maximum adhesion during braking. The thermal heat dissipation design characteristics of the LRT Car brakes account for all operational scenarios (i.e. continuous round-trip, station dwell time, emergency operation, etc.)	OHA and FMEA required. Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______________ Date: ________
Reviewed by: ______________ Date: ________
Approved by: ______________ Date: ________

System Element: LRT Prop/Braking Control

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
PRPBK-3	Excessive acceleration/ deceleration of LRT Car due to improper operation or control failure.	Potential for minor injury to standing passengers resulting from falls experienced during excessive acceleration/ deceleration maneuvers.	III / c	Operating rules will require that the LRT Car operator adhere to speed limits when entering and leaving station stops. The LRT Car will be designed to accommodate a jerk rate limit for power and service braking conditions, under all LRT Car weight conditions.	Verify requirement during PDR and FDR. Verify functionality by test.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______________________ Date: __________
Reviewed by: ______________________ Date: __________
Approved by: ______________________ Date: __________

System Element: LRT Trucks/Suspension

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
TKSUS-1	Truck/truck component failure due to inadequate design, manufacturing defect, improper maintenance.	Potential for serious injury/death to passengers as a result of derailment of LRT Car/s. Damage to track and/or facilities. Service interruption/cessation.	I / D	Specify adequate design margin. Validate structural integrity via finite element analysis. Where required, (i.e. journal bearings, wheels & axles), AAR design criteria will be implemented. Conduct periodic inspections and maintenance of truck hardware.	Verity during PDR and FDR. OHA and FMEA required.

Prepared by: ____________ Date: ______
Reviewed by: ____________ Date: ______
Approved by: ____________ Date: ______

System Element: LRT Car Operator Controls

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
OPC-1	Loss of train control due to equipment faults, operator error/impairment.	Potential for serious injury/death to passengers/employees. Potential for train collision and derailment. Track/facility damage. Service interruption/cessation.	I / D	Failure of safety critical train control functions (i.e. over-speed detection, braking) will be detected and indicated to the operator. A fail-safe design philosophy will be implemented. A *deadman* control device, or vigilance system will be implemented. Use of inter-locks will ensure operation from the active cab only. Emergency stop capability from each car will be provided.	Verify during PDR and FDR. OHA and FMEA required.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: LRT Car Operator Controls

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
OPC-2	Inadvertent actuation, or improper use of safety critical train systems/controls (i.e. coupler switch, emergency stop pushbutton)	Potential for serious injury/death to passengers/employees. Potential for train collision and derailment. Service interruption.	I / D	The cab console layout will be arranged such that controls most frequently used are closest to the operator. MIL-STD-14726, Human Factors Design Criteria will be used in determining size, shapes and colors of controls and indicators. Where appropriate, switches will be guarded to prevent inadvertent contact and actuation. No single inadvertent operator action should cause a catastrophic hazard.	Require Human Factors Report addressing the cab layout design, and operability. OHA required.

Prepared by: ______________________ Date: __________
Reviewed by: ______________________ Date: __________
Approved by: ______________________ Date: __________

System Element: LRT Car Operator Controls

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
OPC-4	Unauthorized entry into operator cab, or occupancy by person/s during train operation.	Potential for injury to the operator, placing the train in an unsafe mode, and disrupting operator abilities to maintain service. Service interruption.	II / D	LRT Car operators will lock cab doors during train operations. Rear-end cabs will also be locked during train operations. Secure yard conditions will exist during out-of-service times. System inhibits (trip stops); dispatch clearance requests need to be negotiated, if train is commandeered.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System - Preliminary Hazards List	 **Prepared by:** ____ **Date:** ____ **Reviewed by:** ____ **Date:** ____ **Approved by:** ____ **Date:** ____
System Element: Signaling	**Hazard Severity:** I Catastrophic II Critical III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
SIG-1	Loss of, or incorrect wayside signal aspects due to failure of signaling component or equipment failure.	Potential for train collision and/or derailment. Potential for serious injury/death to passengers and employees. Track/property damage. Service interruption.	I / D	Loss of wayside signaling is minimized by the use of redundant vital components, which if fail, would be in the most restrictive state. Wayside signals are placed at safe braking distances from the fouling points of switches. In the immediate loss of wayside signals, the signal system enables a safe state to be met via existing train detection, movement authority and route security parameters.	Verify during PDR and FDR. OHA and FMEA required.
SIG-2	Loss of, or incorrect wayside signal aspects due to vandalism of signaling equipment.	Potential for train collision and/or derailment. Potential for serious injury/death to passengers and employees. Track/property damage. Service interruption.	II / D	Signaling equipment housings, cases, and junction boxes will be fabricated of steel and/or aluminum construction with locking panels to prevent inadvertent entry. Where deemed necessary by the Contractor, additional physical protection can be maximized by use of intrusion detection devices.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Sinnalinq

Hazard Severity:
I Catastrophic   II Critical
III Marginal   IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
SIG-3	Loss of block detection capability due to component or equipment failure.	Potential for train collision and/or derailment. Potential for serious injuries/death to passengers and employees. Track/property damage. Service interruption.	I / D	Loss of block detection capability will be minimized by use of track circuits with redundant vital functions. The Control Center will automatically be updated with local block information corresponding to train location and can make available to the operator if required. Fail-safe design will be implemented to ensure that train presence in a section will be maintained if a train is actually in the section, and that the route stays locked.	Verify during PDR and FDR. OHA and FMEA required.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________ Date: ____________
Reviewed by: ____________ Date: ____________
Approved by: ____________ Date: ____________

System Element: Sinnaling

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
SIG-4	Loss of switch/interlocking capability due to adverse environmental conditions (i.e. snow, ice)	Potential for train collision and/or derailment. Potential for serious injury/death to passengers and employees. Service delays or service cancellation. Switch/track damage.	I / D	Switch mechanisms will utilize heating elements to prevent ice build-up on rail surfaces. Frequency of trains help minimize the time switches/interlockings will be exposed to elements. Under severe conditions tracks will be cleared via use of special equipment (i.e. blow-torches), and maintenance vehicles.	Verify during PDR and FDR. OHA and FMEA required.

System Element: Signaling

Hazard Severity:

I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
SIG-5	Grade crossing gates/warning devices inoperative due to train approach detection failure, damaged/broken gate, or loss of power.	Potential for serious injury/death to passengers and employees due to train/motor vehicle collision resulting in derailment. Potential for serious injury/death to person/s being struck by train.	I / C	Crossing warning indication (lunar white) will be indicated to the LRT Car operator if gates are stuck open, requiring stopping of the train. LRT Car operators should report broken gates, etc. if seen. Train detection systems will use redundancy of vital functions. Grade crossing warning systems will include 8 hrs standby power capability. Railroad having maintenance responsibility for the warning system will initiate efforts to warn road users and railroad employees at the crossings, and set up detours.	

Southern New Jersey Light Rail Transit System Preliminary Hazards List

Prepared by: ________ Date: ________
Reviewed by: ________ Date: ________
Approved by: ________ Date: ________

System Element: Signaling

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
SIG-6	Signal violation by LRT Car Operator due to lack of visibility, misinterpreted aspect, fatigue, etc.	Potential for serious injuries/death to passengers and employees resulting from derailment or collision. Track and/or property damage. Service interruption.	II I c	Wayside signals will be provided with lenses to enable a clear distinction of their **aspects** at both close and long ranges. LRT Cars will have windshield wipers/washer and defrost mechanisms. Aspects to be used will be in compliance with FRA regulations, minimizing confusion. Operator schedules will be required to reflect adequate layover time.	
SIG-7	Disregard of, or inability to slow or stop train within signalized section as required.	Potential for serious injuries/death to passengers and employees resulting from derailment or collision. Track and/or property damage. Service interruption.	II / D	Utilize positive stop enforcement – Each signal will be equipped with a trip stop device at the signal's location, and the LRT Car's will be equipped with an onboard inductive antenna. If an LRT Car passes a red signal the trip stop device will automatically apply the LRT Car brakes before the danger point is reached, consistent with the allowed speed for that section.	Verify during PDR and FDR. OHA and FMEA required.

Prepared by: ____ Date: ____
Reviewed by: ____ Date: ____
Approved by: ____ Date: ____

System Element: Communications

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
COM-1	Loss of emergency call-for-aid service in stations (WRTC, NEC) so equipped, due to component failure, improper use, vandalism.	Unable to secure aid for victim of accident/assault. Unable to report suspicious activities. Unable to report LRT Car emergency.	II / C	Emergency Call-For-Aid units will be dedicated, hardened speakerphones with automated dialing capability. The units will be flush-mounted with hands free speakerphones built into the panel. Calls will be activated by pressing a button and speaking into an integrated microphone/ speaker. The units will use redundant internal components to minimize outages.	Verify during PDR and FDR.
COM-2	Loss of public phone service at station stops due to equipment failure, or vandalism.	Unable to access emergency 911 services. Unable to access passenger assistance service for schedule information/changes.	I / C	Two telephones per platform are provided to minimize loss of service. The local telephone service provider will perform standard maintenance of these telephones. Security patrols will minimize occurrences of vandalism to station stop property.	Verify via System Security Plan.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____ Date: ____
Reviewed by: ____ Date: ____
Approved by: ____ Date: ____

System Element: Communications

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario/ Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
COM-3	Loss of radio communications between Central Control and LRT Car due to power interruption, component failure, RFI. etc.	Central Control unable to assess abnormal or emergency conditions. LRT Car operator unable to advise Central Control of service delay, system emergency. Loss of silent alarm notification capability from LRT Car to Central Control.	II / c	Central Control facilities will have UPS capability. Central Control communication facilities will have "hot back-up" capability. LRT Car radio outages are minimized by the use of a trunked radio system, such that failure of a single channel or channels will not impact voice communications. RF Coverage analysis to be performed.	Verify during PDR and FDR.
COM-4	Loss of monitoring capability and supervisory control at the Control Center due to external events (tire, intrusion), or accidental damage during maintenance actions.	Failure to detect and advise field operations of unsafe conditions in a timely manner. Potential for serious injury/death and equipment damage.	I I / C	Provide supervised system with provisions for routine checks. The Control Center will be designed in accordance with, and the equipment will be installed in compliance with *BOCA, NEC, UL,* to address electrical hazards associated with structures used in this manner. Employing redundancy in components, and software features will minimize loss of monitoring capability.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Communications

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
COM-5	Ineffective and/or incorrect information provided to transit/freight services due to confusion or misinterpretation of instructions by the dispatcher.	Potential for delay in response to LRT/freight service under abnormal or emergency situations. Incorrect route setting identified to transit/freight operator. Potential for serious injury/death to passengers, employees due to derailment/collision as a result of incorrect route setting. Property damage and service interruption.	II / C	Information displayed on control Center consoles will be logical and structured to indicate messages according to priorities. Information will be categorized into specific groups to enhance dispatch efficiency. Human factors engineering will be implemented in Control Center design. Dispatchers will be qualified appropriately for service handled.	Verify operations procedures.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: Communications

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
COM-6	Erroneous status indications on Control Center displays due to software/hardware faults.	Potential for incorrect dispatch status/instructions. Service delay.	III / C	Start-up Built-in-Test (BIT) and background software tests will be required of the communications system. Hard faults will be automatically indicated to Control Center personnel for corrective action. Trains experiencing loss of communications with the Control Center can safely proceed under signaling system control.	Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ______ Date: ______
Reviewed by: ______ Date: ______
Approved by: ______ Date: ______

System Element: EMI/EMC/RFI

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
EMI-1	Inherent EMI generated by LRT Car propulsion equipment, or malfunction of power system.	Potential for incorrect wayside signal control. Disruption of various communications functions resulting in loss of system performance, and placing train in unsafe state.	II / D	Design LRT Car subsystems to be compatible with surrounding EMI. Perform RF susceptibility analysis to identify spectrum of interference to signaling and communication equipment. Implement EMI Control Plan. Utilize shielded cables, shielded wiring, and EMI leak-proof gaskets as appropriate to suppress EMI field pick-up as required.	Require EMI Control Plan prior to PDR. Verify during PDR and FDR.

Southern New Jersey Light Rail Transit System Preliminary Hazards List	Page: 39 of 43 Prepared by: ______ Date: ______ Reviewed by: ______ Date: ______ Approved by: ______ Date: ______
System Element: System-wide	Hazard Severity: I Catastrophic II Critical III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
SYS-1	Threats (e.g. bomb) via telephone or letter (these may be real or hoax).	Service interruption. Passenger and employee fear. Potential for decreased ridership.	II / D	System critical areas (e.g. Yard & Shop facilities) will have access control. The System Security Plan for operations will identify contingencies to be taken, and coordination of law enforcement agencies.	Verify in System Security Plan.
	Sabotage by disgruntled employees.	Potential for serious injury/death to passengers/employees/public. Property damage.	I / D	Minimize potential by requiring prompt management attention to grievances raised. Promote alertness on the part of supervisory and worker staff. Limit **access** to critical areas to authorized personnel.	

Southern New Jersey Light Rail Transit System Preliminary Hazards List	 Prepared by: ____ Date: ____ Reviewed by: ____ Date: ____ Approved by: ____ Date: ____
System Element: System-wide	Hazard Severity: I Catastrophic II Critical III Marginal IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
SYS-2	LRT service disruption due to adverse weather conditions, (i.e. flooding, blizzard or high winds).	Potential for system delays, stranded trains. Potential for situation requiring evacuation of passengers.	III / c	Criteria defining adverse weather operations will be developed including identifying when operations should be suspended. LRT Cars will be equipped with sanding systems to assist wheel traction. LRT Cars by design have a low cg thus having a high degree of stability/resistance to overturning moments caused by high winds. Track primarily at-grade minimizing LRT Car/s exposure to high winds that can be present at elevated sections and open bridges.	Verity during PDR and FDR. Verify coordination program with Emergency Response Agencies.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________________ Date: __________
Reviewed by: ____________________ Date: __________
Approved by: ____________________ Date: __________

System Element: Maintenance-On Track

Hazard Severity:
I Catastrophic II Critical
III Marginal IV Negligible

Hazard Number	Hazard Scenario/ Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
MAINT-1	Structural deficiency of track, or excessive deterioration due to poor material quality, manufacturing flaws, dynamic loading, defective welds, improper installation/maintenance actions.	Potential for serious injuries/ death to passengers and employees due to derailment. Service cessation.	II / D	Apply design and test criteria in accordance with AISC, AREA, and ASTM as required. Perform track maintenance in accordance with FRA regulations defining frequency, inspection criteria, etc. Provide for broken rail detection.	Verify during PDR and FDR. Verify track maintenance procedures and require periodic audits of procedures.
MAINT-2	Failure of track switches due to lack of, or improper maintenance.	Potential for serious injuries/ Death to passengers and employees due to derailment. Service cessation.	II / D	Perform periodic inspection, testing, and adjustment of switches. Ensure positive interface connection between signal and switch mechanisms. Route setting will not be possible across a failed switch. Switch positions can be monitored from the Control Center and made available to the LRT Car operator if required.	Verify during PDR and FDR. Verify track maintenance procedures and require periodic audits of procedures.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____ Date: ____
Reviewed by: ____ Date: ____
Approved by: ____ Date: ____

System Element: Maintenance-On Track

Hazard Severity:
I Catastrophic
II Critical
III Marginal
IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity/ Probability	Possible Controlling Measures and Remarks	Resolution
MAINT-3	Personnel or equipment on track, or in close proximity of track during operating hours due to repair/maintenance activities in progress.	Potential for serious injury/death to worker/s if struck by LRT Car/s.	II / c	All work on the right-of-way will be performed in accordance with the safety rules of the operating railroad company (i.e. NJ Transit Rail Employee On-Track Safety Procedures, and the Specific Requirements of CONRAIL For Work On Its Right-Of-Way).	Verify worker safety audits are required in System Safety Program Plan.
MAINT-4	Failure of track related components (joints, fasteners, ties, etc.).	Effects may range from personnel injury/fatality to equipment and property damage. The degree of severity will vary with the individual hazard, however, the possibility of derailment is much greater.	I / D	Adhere to standard design, inspection and maintenance practices. Ensure LRT Car/track designs are compatible.	Verify during PDR and FDR. Verify track maintenance procedures and require periodic audits of procedures.

Southern New Jersey Light Rail Transit System
Preliminary Hazards List

Prepared by: ____________ Date: ________
Reviewed by: ____________ Date: ________
Approved by: ____________ Date: ________

System Element: Maintenance-On Track

Hazard Severity:
I Catastrophic — II Critical
III Marginal — IV Negligible

Hazard Number	Hazard Scenario Description	Effect on Personnel/Transit System	Hazard Severity / Probability	Possible Controlling Measures and Remarks	Resolution
MAINT-5	**INTENTIONALLY LEFT BLANK**				

Exhibit E

SNJLRT Diesel Light Rail Car Specification

2 Light Rail Transit Car

2.1 Overview

The LRT Car shall:

(a) have a diesel engine as the primary power source
(b) be powered by either diesel-mechanical or diesel-electric drive system
(c) have a braking system which includes dynamic, friction, and track brakes
(d) have steel wheels, for operation on track, as defined in subsection 2.2.2
(e) provide a low floor area of at least 60 % of the total passenger floor area, as defined in subsection 2.2.1
(f) be bi-directional with an operator's cab at each end
(g) be equipped with a fully automatic electric and mechanical coupler at each end
(h) have all doorways located in the low floor area, with doorways on each side directly opposite one another
(i) be equipped to allow the operator, while in the seated position, to view passengers entering and exiting the doorways along the length of the car or consist
(j) be equipped for safe loading of all passengers at all platforms, in a manner which complies with the Americans with Disabilities Act (ADA)
(k) comply with all Governmental Rules regarding light rail transit systems.

The LRT Cars shall be capable of operating individually and in consists of at least two LRT Cars. Requirements for LRT Cars shall generally also be requirements for consists.

An operating LRT Car shall be capable of coupling with **a** failed LRT Car, with either car at any load, and moving to the next or previous station stop to evacuate passengers from both cars. The consist shall then be able to return to the maintenance facility from any point on the SNJLRTS. The procedure for handling such emergency scenarios shall be addressed in the Operating Procedures required by **Book III: Project Provisions, Section 4.5.**

LRT Cars shall have additional recovery capabilities if necessary to support the operating procedures.

Under normal service conditions with adequate maintenance and inspection, the carbody and trucks shall be designed for a 30 year life without structural repairs or alterations.

2.2 Operational Requirements

2.2.1 Mandatory Dimensions

The maximum consist length, measured over coupler faces, during normal operating service shall not exceed 205 feet. Refer to **Part B, Section 3.2.3.**

The maximum width of an LRT Car shall not exceed 122 inches.

The maximum height of an LRT Car shall not exceed 154 inches from top of rail to top of car, including all roof-mounted equipment.

The height of the finished interior low floor level above top of rail shall not exceed 24 inches, as measured at door thresholds.

The total passenger floor area shall include all areas used in the calculation of seated and standing capacity.

The swept envelope of an LRT Car at any loading, when operating on the minimum horizontal radius curve specified in subsection 2.2.2. shall provide a minimum clearance of 24 inches between the LRT Car and any permanent stationary object alongside the track Right-of-Way, and between two LRT Cars. Refer to **Book VI: Standard Drawings for** swept envelope and structure clearance drawings.

2.2.2 Track Geometry

The LRT Cars shall be designed to operate, with no physical interference, over all tracks on the Project, in all possible consist arrangements. The track characteristics of the Project are defined in **Part B, Section 2: Route Alignment** and **Part B, Section 4: Trackwork.** The LRT Car(s) shall also be capable of operation over track with the following characteristics:

(a) Track Gauge		4 feet 8½ inches
(b) Minimum Horizontal Radius		**132** feet
(c) Minimum Vertical Radius (sag)	See Part B, section 2.2.3.4	
(d) Minimum Vertical Radius (crest)	See Part B, section 2.2.3.4	
(e) Maximum Superelevation		6 inches
(f) Maximum Grade		**6%**
(g) Minimum distance from Centerline of Track to Platform Edge		58 inches

2.2.3 Car Capacity

LRT Cars shall be operated in consists of one or more cars for revenue service. The seating capacity of the operating consists shall be sufficient to meet the system capacity as stated in **Book III: Project Provisions, Section** 4.2.2. The seating layout shall accommodate a minimum of two wheelchair locations per LRT Car.

2.2.4 Car Weight

The loading of each LRT Car, including passengers, are defined as follows:

AWO (tare)	Maximum weight of LRT Car without passengers and operator, ready to run with fuel tank and sand boxes full
AW1 (seated)	AWO plus seated passengers and operator
AW2 (full)	AW1 plus standees @ 2.7 feef per passenger
AW3 (crush)	AW1 plus standees @ 1.8 feet^2 per passenger
AW4 (structural design)	AW1 plus standees @ 1.35 feef per passenger

These definitions shall be applied for design and testing purposes, and the average passenger weight shall be 165 Ibs.

2.3 Carbody Requirements

The following terms, as used in this section, are defined as follows:

(a) Belt rail	a structural member attached to the interior sidewalls below the side windows and used to locate and secure vertical members in the carbody
(b) Collision post	a vertical structural member of the end structures extending from the under-frame to the structural shelf, which provide protection from objects penetrating into the vehicle during a collision
(c) Corner post	the vertical structural member at each corner of the frame of the carbody, which extends up from the under-frame structure to the roof structure (may be combined with the structural shelf and collision posts to become part of the end structure)
(d) Coupler anchorage	the structural member of the underframe which is used for attaching the coupler assembly to the under-frame
(e) Coupler release load	the load level which when applied to the coupler face, results in the coupler assembly being separated from the coupler anchorage bracket or from the underframe
(f) Crashworthiness	the ability of a carbody to absorb the energy of a collision in a gradually increasing and controlled manner without compromising the integrity of the structure in the passenger compartment, and so limiting the deceleration of passengers within this compartment
(g) End sill	the transverse structural member of a car under-frame which extends across the ends of the longitudinal sills and connects to the side sills
(h) End sill load	a longitudinal compressive force applied at the ends of the car, specifically at the anticlimber/end sill
(i) Side sill	the outside longitudinal members of the underframe
(j) Structural shelf	the horizontal structural member located at the base of the windshield, which attaches to the collision posts and the corner posts to form the operator's front shield
(k) Anticlimber	Transverse structural member at the ends of the vehicle, typically attached to the end sill, designed to prevent vehicles from over-riding in the event of a collision.

2.3.1 Crashworthiness

Consists shall be capable of withstanding collisions with other consists, road vehicles, or over-travel buffers without unnecessary risk of injury to passengers or excessive damage to LRT Car and track equipment. In a collision, no passenger compartment shell shall rupture or suffer any opening through which passengers' limbs may protrude; no components within the engine compartment shall become dislodged and penetrate into the passenger compartment; high voltage devices and associated connecting cables shall remain contained and shall not create electrical shock hazards to personnel; and electrical and diesel systems shall not create a fire hazard.

In a collision between a consist moving at speed V and a stationary consist with:

- both consists on level tangent track and unbraked
- couplers fully engaged
- either consist comprising of any number of cars normally used in revenue service
- any LRT Car having a weight of AWO.

(a) For $V \leq 5$ mph, there shall be no damage to any LRT Car or equipment, and the maximum longitudinal acceleration measured in any passenger compartment shall not exceed 1 .O g.

(b) For 5 mph $< V \leq 15$ mph, damage shall be confined to the expendable energy absorption devices and sacrificial structural members at the ends of the LRT Cars, which shall be repairable. The primary structure enclosing the passenger compartment(s) shall remain intact, with no permanent deformation of any of its members. The maximum longitudinal acceleration measured in any passenger compartment shall not exceed 2 g.

2.3.2 **Carbody** Design Loads

2.3.2.1 Static Vertical Load

A static vertical load corresponding to an LRT Car uniformly loaded to AW4 shall not cause stress levels in any structural member to exceed 50% of the yield or buckling strength.

2.3.2.2 Fatigue Load

With a fluctuating load due to AW2 passenger loading and unloading, the mean stress shall be less than that which determines the allowable fatigue endurance limit taken for 2 million cycles (using the Structural Welding Code, ANSI/AWS D1.l: Structural Welding Code for Steel and ANSI/AWS D1.2: Structural Welding Code for Aluminum).

2.3.2.3 End Sill Load

With the vehicle uniformly loaded to AW4, the end sill structure shall be capable of:

- Sustaining loads up to the peak collapse load of the crush zone without permanent deformation.
- Sustaining the reaction loads generated from the loads specified in Section 2.3.2.5 Collision Posts, Section 2.3.2.6 Corner posts and Section 2.3.2.8 Anticlimbers without permanent deformation.
- Distributing the collision loads incurred during scenarios specified in Section 2.3.1 Crashworthiness, such that collapse of the energy absorption elements in the crush zones is the primary failure mode.

Additionally, the passenger compartment shall be capable of sustaining, without any permanent deformation, 1.5 AWO longitudinal loads applied uniformly at the ends of the passenger compartment, with a uniformly distributed AW4 vertical load.

2.3.2.4 Coupler Anchorage

The carbody structure supporting the coupler shall sustain without permanent deformation a load that is equal to 110% of the coupler release load (if applicable) or failure load applied at the coupler brackets, with a uniformly distributed AW4 vertical load.

The method of attaching the coupler to the coupler anchor bracket(s) shall allow the coupler to become fully released from the coupler anchor bracket(s) once the coupler has absorbed its maximum design energy. Upon release, a method shall be provided to contain the coupler and prevent it from coming in contact with the track or from protruding into the passenger compartment.

2.3.2.5 Collision Posts

Collision posts or a structural equivalent shall be provided, protecting at least the area between the underframe and the bottom of the windshield.

In order to preclude sudden catastrophic failure or telescoping of **LRT** Cars, all connections which attach the collision posts, corner posts and structural shelf to each other and/or the underframe structure and roof structure, shall be done in such a manner as to develop the full strength of the load bearing members in shear.

The ultimate shear strength of the collision posts shall be not less than a compression load of AWO applied at the top of the underframe, and at any angle up to ±15° from the longitudinal axis.

A compression load of 0.5 AWO similarly applied 15 inches above the top of the under-frame shall cause no yielding of the collision posts.

2.3.2.6 Corner Posts

Corner posts or a structural equivalent shall be provided. The ultimate shear strength of the corner posts shall be not less than a compression load of 0.5 AWO applied at the top of the underframe.

A compression load of 0.3 AWO applied 15 inches above the top of the underframe, or at the level of the structural shelf, whichever is higher, and applied in any direction, shall cause no yielding of the corner posts.

2.3.2.7 Structural Shelf

A compression load of 0.3 AWO applied anywhere along the structural shelf or a structural equivalent between the collision posts, or between the collision post and corner post, shall cause no yielding of the carbody structure.

2.3.2.8 Anticlimbers

With only two ribs of the anticlimbers engaged, and a vertical load of ±40,000lbs combined with a longitudinal compressive load of AWO applied at the carbody centerline, there shall be no permanent deformation of the carbody structure.

2.3.2.9 Side Wall Load

With a compression load of 40,000lbs applied to the side wall at the side sill, and distributed along 8 feet, and a compression load of 10,000lbs applied to the side wall at the belt rail, there shall be no yielding or bucking of the carbody structure.

2.3.2.10 Diagonal Jacking

With the LRT Car properly supported by all side sill jack pads and the trucks attached, it shall be possible for any one jack to be lowered to a level of 10% of the AWO load. The lowering of any jack shall cause:

- no permanent deformation of the carbody structure
- no distortion in the window frames
- no degradation to the window glass and glazing
- no degradation to the water tightness of any carbody seam.

2.3.2.11 Truck Attachment to Carbody

The truck to carbody attachment shall withstand a load of 5.0 g on the truck weight applied in any horizontal direction, or a load of 2.0 g on the truck weight applied in the vertical direction, without separation of the truck from the carbody.

The truck safety support shall not create an electrical connection between the truck frame and the carbody.

2.3.2.12 Equipment Support Design Loads

The underfloor, roof-mounted and engine compartment equipment, weighing greater than 200lbs, shall be designed to withstand not less than 5.0 g in the longitudinal direction, 2.0 g in the lateral direction, and 3.0 g in the vertical direction. These loads, applied separately, shall not result in stresses that exceed 90% of the yield or buckling strength of the material.

2.3.2.13 Roof Load

The roof shall have sufficient strength to support, without permanent deformation, concentrated loads of 250 lbs per person as applied by a person walking on the roof, with a maximum of three (3) persons at any time.

2.3.3 Structural Design Documentation and Testing

The Contractor shall submit, for review and approval by the Owner, a Crashworthiness Finite Element Analysis Report (CDRL), which demonstrates compliance with the requirements of Section 2.3.1, and details the characteristic deformation of the carbody structure.

The Contractor shall submit, for review and approval by the Owner, a Structural Design Load Finite Element Analysis Report (CDRL), which demonstrates compliance with the requirements of Section 2.3.2, and details the characteristic deformation of the carbody structure.

The Contractor shall submit, for review and approval by the Owner, a Collision Energy Absorption Analysis Report (CDRL), which identifies the contributions made by the coupler and each structural member, to the overall energy absorption.

The Contractor shall submit, for review and approval by the Owner, a Carbody Structural Test Specification (CDRL) detailing the test methodology to demonstrate compliance with the requirements of Sections 2.3.2.1-2.3.2.4, 2.3.2.10 and 2.3.2.13, and a Carbody Structural Test Report (CDRL) detailing the subsequent test results. If desired, these tests may be specified, carried out and reported separately.

The Contractor shall submit, for review and approval by the Owner, an Equipment Load Factor Calculation (CDRL) demonstrating compliance with Section 2.3.2.12.

2.3.4 Fire and Toxicity Protection

2.3.4.1 Fire Resistance

The resistance of the floor assembly to an underfloor fire shall, for a minimum duration of 15 minutes, meet the fire endurance requirements specified in NFPA 130: Standard for Fixed Guideway Transit Systems and ASTM E-l 19: Standard Test Methods for Fire Tests of Building Construction and Materials.

The LRT Car end caps, roof, floor and any interior equipment enclosures shall be designed to prevent propagation of a fire to the LRT Car interior.

2.3.4.2 Flammability and Smoke Emission

Interior materials shall meet the requirements specified in NFPA 130: Standard for Fixed Guideway Transit Systems.

2.3.4.3 Toxicity

Only materials commonly accepted as being safe for use in mass transit vehicles shall be used in the manufacturing of the LRT Car and all its components. These materials shall have known by-products of combustion. Polyvinyl chloride and other materials that are known to release toxic substances shall not be used.

2.3.4.4 Fire and Toxicity Documentation and Testing

The Contractor shall submit, for review and approval by the Owner, a Fire and Toxicity Protection Program Report (CDRL), which demonstrates compliance with the requirements of subsection 2.3.4. This shall include:

(a) Description of design in specific areas of fire risk
(b) List of materials to be used for floor and interior fittings
(c) Fire load calculations, as appropriate
(d) Test plan

2.3.5 Electrical Equipment and Wiring

Electrical equipment shall conform to the requirements specified in NFPA 130: Standard for Fixed Guideway Transit Systems or equivalent recommendations and specifications from comparable international agencies as applicable. NFPA 70: National Electrical Code shall be applied, as appropriate, as a guideline.

All motor leads shall have insulation suitable for the intended operating environment and shall be supported and protected to minimize the chance of damage.

Electrical circuits and associated cabling shall be designed with gap and creepage distance between voltage potentials and carbody ground in accordance with the environmental conditions to which the circuits and cabling will be subjected.

The insulation for all internal wires and cables shall be flame retardant and be specifically formulated to minimize smoke, noxious emissions or corrosive fumes in the event of severe overheating or fire. Materials used for the insulation shall be substantially free (less than 1% by weight) of halogens, phosphorus, sulfur and nitrogen.

Wires and cables shall be designed to minimize insulation weight and combustible material but shall still be resistant to mechanical stresses, fluids and extreme temperatures.

For wires (smaller than AWG 6), the maximum finished wire diameter shall be in accordance with MIL-W-8104419: “Wire, Electric, Cross-linked Polyalkene, Cross-linked Alkane-imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy”, or metric equivalent.

For cables (AWG 6 and larger), the maximum insulation thickness shall be in accordance with ICEA-S66-524: “Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for the

Transmission and Distribution of Electrical Energy", Table 3-1, or metric equivalent (IEC 60228 class 5).

The maximum jadket thickness for multi-component cables shall be in accordance with ICEA-S-66-524: "Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy", Table 4-7.

Conduit shall be sized to allow for 20% spare capacity above the capacity required for the vital wires and cables.

2.3.6 Windshield Impact Strength

Cab windshields shall meet the ballistic and large object impact requirements for a type I specimen, as specified in 49 CFR: Transportation, part 223: Safety Glazing Standards – Locomotives, Passenger Cars and Cabooses.

2.3.7 Side Window Impact Strength

Side windows shall meet the impact requirements of ANSI Z26.1, Table 1, Item 1: American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways.

2.3.8 Stanchions, Grab Rails, and Windscreens

Stanchions and grab rails shall be sized and located to provide optimum arrangement for all passengers. They shall be of a color distinguishable by the partially sighted.

Windscreens shall be provided adjacent to each doorway, with at least the upper half transparent, and shall incorporate a stanchion extending from the windscreen to the LRT Car ceiling.

2.3.9 Interior Layout

Each LRT Car shall have a minimum of two designated 30 inch by 48 inch wheelchair spaces, which meet ADA requirements. The spaces shall be accessible from the doors by a route with a clear width of at least 32 inches.

The car shall predominantly have 4 abreast transverse seating (2 by 2 with an aisle in between), with a clear aisle width at least 32 inches. Each seat shall be separated from the side wall by a one-inch spacer and from the adjoining seat by a two-inch spacer.

The minimum seat pitch shall be 29.5 inches for a knee-to-back transverse seat orientation. For longitudinal seats and seats which face the bulkheads and dividers, the minimum distance for knee room measured from the seatfront edge shall be 14 inches.

2.3.10 Exterior Finish

The exterior of the LRT Car shall be painted in two base colors, with two accent colors applied. The LRT Car shall carry the logo of NJ Transit. The Contractor shall, within 6 months after Notice to Proceed, submit for review and selection at least three Color Scheme Alternatives (CDRL) for the interior and exterior of the LRT Cars, together with Material Swatches (CDRL) for seat covering and interior panels. The review period shall be up to 6 months and shall be scheduled into the LRT Car manufacturing process.

2.3.11 Passenger Seats

Each passenger seat shall have a width of at least 17 inches. The passenger seat shall consist of a cantilevered supporting structure, shell and cushion inserts for the seat and back. The size, shape and contour of the shell and cushions shall be designed to accommodate a range of people from the fifth (5^{th}) percentile female to ninety-fifth (95^{th}) percentile male of the general population, as defined in MIL-STD-1472D: Human Engineering Design Criteria for Military Systems, Equipment and Facilities.

2.3.12 Advertising Card Frames

Frames shall be provided throughout the LRT Car interior to accommodate advertising cards. The size, quantity and location of advertising frames shall be approved by the Owner prior to manufacturing of the LRT Cars.

2.3.13 Event Recorder

Each LRT Car shall be provided with an on-board event recorder which:

(a) monitors LRT Car performance
(b) assists investigation into incidents
(c) complies with 49 CFR 229.135 Event Recorders

The event recorder shall be capable of protecting the stored data from shock impact, crushing, magnetic interference, fluid immersion and fire. It shall be possible to store and record a minimum of 48 hours of data in the event of absence of power. New data shall replace the oldest data (First-In, First-Out configuration) in memory. The event recorder shall be tamperproof, and shall not be accessible by the operator. As a minimum, the following signals shall be recorded:

- Time
- Speed
- Distance
- Propulsion mode
- Braking mode
- Trip stop status
- Door status
- PA status
- Exterior light status

2.3.14 Fault Monitoring System

A software controlled fault monitoring system shall be provided. As a minimum, it shall provide the following functions:

- Monitor and store subsystem, car and consist data in non-volatile memory
- Identify subsystem faults and failures
- Display and annunciate to the operator all critical faults and failures which affect the serviceability of the vehicle
- Provide data for periods before, during, and after an incident of fault or failure.

A visual display and the capability of downloading the stored data shall be provided. There shall be 3 spare digital and 3 spare analog input/output ports per fault monitor.

2.3.15 Hour Meter

An hour meter display shall be provided in each car in a location easily accessible to maintenance personnel. The hour meter shall be activated and deactivated by the start-up and shut down of the diesel engines from the active cab.

2.4 Coupler and Draft Gear

The coupler and associated draft gear system shall have a centering device that retains the unconnected coupler head within its gathering range. This system shall provide electrical and pneumatic trainline connections to enable the lead LRT Car to-control all other LRT Cars within a consist. In the electrical contact block, spare contacts shall amount to at least 10 percent of the total number of contacts.

The coupler and draftgear shall withstand an operating consist with an AW3 passenger load, pushing or pulling an unpowered consist with an AW3 passenger load, over all grades and curves on the alignment, without damage to the coupler.

In the event of a collision, energy absorption through the coupler shall be via gas-hydraulic regenerative dampers or equivalent.

In the event of an accidental consist separation, each LRT Car of the consist shall automatically command application of its emergency brakes.

2.5 Operator's Cab

2.5.1 Cab Controls and Indicators

The cab console at each end of the LRT Car shall be functionally identical. The cab and equipment shall be ergonomically designed for operators in the range of fifth (5^{th}) percentile female to ninety-fifth (95^{th}) percentile male of the general population, as defined in MIL-STD-1472D: Human Engineering Design Criteria for Military Systems, Equipment and Facilities.

Malfunctions and failures of safety-critical vehicle systems shall be detected and annunciated to the operator on the cab console.

A master *controller* shall be provided *in* each cab, and equipped with a "deadman" feature. A keyed control switch shall be provided, which is interlocked such that only the master controller at the front end of the lead LRT Car of a consist is operable. All keyed control switches shall reset to one master key.

An emergency stop push-button shall be provided such that, when pushed, it will activate the emergency brakes. It shall be possible to activate the emergency stop push-button from any console in a consist.

The door controls shall be separate for left and right side doors and shall be on the same side of the operator's cab console as the doors which they operate. The design of the door control signal shall ensure that non-commanded doors will not open except as described in subsection 2.6.4.

In order to by-pass the enforced stop device as defined in subsection 2.12.3, a sealed switch shall be provided within each cab. Activation of this switch shall be stored within the memory of the event recorder as defined in subsection 2.3.13.

2.5.2 Operator's Visibility

The windshield and operator's side windows shall permit an operator's field of view, as measured in Society of Automotive Engineers (SAE) J1050: Describing and Measuring the Driver's Field of View, for the 5^{th} percentile female to the 95^{th} percentile male.

A minimum vertical upward view shall be not less than 15 degrees.

The operator, from a normal seated operating position, shall be able to see a 3 foot 6 inch tall child, when the child is standing two feet away from the sides of the LRT Car, in an area defined by the plane parallel to the back of the operator's seat and forward; and when the child is standing two feet in front of the LRT Car coupler.

The horizontal line of sight shall be a minimum of 90 degrees to the left and to the right of the operator without their view being distorted. Any binocular obscuration in the operator's field of view shall not exceed:

- 3 degrees due to a center divider
- 10 degrees due to the windshield pillars.

The operator, from a standing position, shall be able to see the head of the coupler.

The windshield shall be designed and installed to minimize external reflections, as well as reflections from inside the LRT Car. During night operations with the passenger interior lighting on, there shall be no reflections visible in the windshield immediately in front of the operator.

2.5.3 Engine Starting and Shutdown

The engine(s) shall be started and shutdown from within the active cab of a LRT Car. The cab controls shall have the capability to control the startup and shutdown of the engines within a normal operating consist.

2.5.4 Audible Exterior Warning Devices

A horn and a bell shall be provided at both cab ends of the LRT Car. The horn shall be equipped with both high and low output volumes. Control of each shall be by separate, momentary contact switches located on the cab console. The horn output level shall be 95 ± 2 dbA at the high level and 85 ± 2 dbA at the low level, measured at a distance of 100 feet. Both high and low horn levels shall be operable from the operator's console. The bell output level shall be a single level output of 80 dbA minimum measured at 50 feet. These devices shall be operable from the active cab only.

2.5.5 Portable Fire Extinguishers

An Underwriter's Laboratories (UL) approved industrial grade, dry chemical portable fire extinguisher with a 10-lb capacity and a minimum rating of 4A-30B:C shall be provided in each cab of the LRT Car. The fire extinguisher shall be provided with marine-type mounting brackets. The location of the fire extinguishers shall be clearly marked.

2.6 Passenger Doors and Steps

2.6.1 Doorway Configuration

Doorways shall be provided on both sides of the LRT Car to meet the following requirements:

(a) Egress time of AW2 load shall not exceed 120 seconds
(b) Egress shall be calculated assuming a flow rate of 2 seconds per passenger per flow lane
(c) Flow lane width shall be at least 24 inches
(d) Minimum doorway clear height shall be 76 inches.

A doorway, provided to the minimum ADA allowed clear width of 32 inches, shall be considered as a single flow lane.

The door type supplied on the LRT Cars shall exclude bi-folding and pocket type doors.

The Contractor shall submit, for review and approval by the Owner, an LRT Car Egress Calculation (CDRL), which demonstrates that the final design is compliant with the requirements of this subsection.

2.6.2 Audible and Visual Warnings for Door Operation

There shall be a visual warning signal located on the vehicle exterior and interior above each doorway to alert passengers to the opening of the doors. There shall be audible and visual warning signals according to ADA requirements to alert passengers of closing doors.

2.6.3 Door Operation

Damping shall be provided at the end of the door's travel in both the opening and closing directions.

The force that a closing door leaf may exert on a passenger shall not exceed 30 lbf.

2.6.4 Sensitive Door Edges

A sensitive leading edge or other suitable device shall be provided on each door leaf to cause both door leaves to stop when an obstruction is encountered. The sensitive door edge material and shape shall be selected and sized to allow the extraction of a hand. The operation of the sensitive-edge obstruction/detection system shall be as follows:

(a) Upon detection of an obstruction, each door leaf in the affected doorway shall cycle open to enable the removal of the obstruction. After an adjustable delay, the doors will attempt to close again. Upon detection of a second obstruction, an alarm shall sound at the door location and in the operator's cab.

(b) The cycle shall repeat until the obstruction is removed or the doors are commanded open. The alarm shall continue to sound until the doors are closed and locked or the doors are commanded open.

(c) The sensitive edge shall become inactive when the distance between edges is 3/8 inch or less.

(d) Not used.

The sensitivity of the obstruction detection system shall be as follows:

(e) It shall detect a flat bar, ½ inch wide and 3 inches high, held rigidly between and perpendicular to the door panel. To provide for adequate connection with the door panel, this sensitivity shall be required everywhere along the length of the door panel, except at the uppermost three inches and lowermost one inch of the door panel.

(f) It shall detect an object 3/4 inch in diameter, held rigidly between and perpendicular to the door panels at all locations along the length of the door nosing seal. This sensitivity shall be required everywhere along the length of the door panel, except at the uppermost three inches and lower most one inch of the door panel.

The force required to activate this feature shall not exceed 15 lbf.

2.6.5 Emergency Manual Release Levers

An emergency release lever shall be provided on the inside of each doorway and for at least one doorway per side on the outside of the LRT Car. This will enable a closed and interlocked door to be lock-released without power supply. Activation of the emergency release levers shall allow the door leaves to be manually moved. The interior emergency door release levers shall be clearly marked and shall be in a location accessible to all passengers, compliant with ADA requirements.

2.6.6 Door Lock Mechanism

A door lock mechanism shall be provided at each doorway to positively retain the doors in the closed position. The lock mechanism shall automatically engage once the closed position has been reached. The lock mechanism shall incorporate a safety circuit which will activate **a** full service brake application if the circuit is disrupted.

2.6.7 Door Interlock

The doors shall be interlocked with the propulsion system to prevent the consist moving while any door(s) are open, and to prevent the doors from being opened from the controls within the cab while the consist is in motion. If any door is forced open or if the emergency release is activated, an irrevocable full service brake application shall result.

Following activation of any emergency manual release lever, and only while the consist is still in motion, it shall require a force of 25 ± 5 lbf per door leaf to open the doors. When the consist is no longer in motion, the force required to open the doors shall not exceed 10 lbf per door leaf.

2.6.8 Floors, Steps, and Thresholds

Floor surfaces on aisles, step treads, places for standees, and areas where wheelchair and mobility aid users are to be accommodated shall be slip-resistant. The side door thresholds shall be designed to interface with the platform geometry. All thresholds and step edges shall have a band of color(s) running the full width of the step or threshold which contrasts from the step tread and riser or adjacent floor.

2.7 Heating, Ventilation and Air Conditioning

2.7.1 Heating, Ventilating, and Air Conditioning

The heating, ventilating and air conditioning system shall be capable of being operated, maintained, and (when not in use) stored within the climatic conditions specified in **Part C, Section1.8: General Systems Requirements.**

2.7.2 Heating

With outside ambient temperatures down to 0 °F and relative humidity in the range of 20% to 100%, in still air, the installed heating capacity shall be sufficient to:

- Maintain a mean temperature in the passenger compartment of 65°F
- Maintain an interior temperature of 41 °F when the LRT Car is in layover heating mode

During the winter months, ventilation air shall be heated to ensure that the fresh air intake does not reduce the temperature of the diffuser output air to uncomfortable levels.

2.7.3 Ventilation

The ventilation equipment shall be designed and maintained to:

(a) Provide sufficient fresh and re-circulating air flow to evenly distribute the heating and cooling energy throughout the passenger compartment and operator's cab to avoid stratification, such that the spatial temperature variation shall not exceed ± 4 °F from the mean.

(b) Introduce fresh air of at least 6 cfm per passenger at AW2 load when the air filters are due for replacement.

(c) Assure that at least 20% of the total airflow through the evaporators is fresh outside air.

(d) Preclude unintended fresh air infiltration by maintaining a positive interior pressure at all operating speeds.

Ventilation air shall be discharged from diffusers designed to provide efficient mixing without direct impingement on passengers, and such that the air velocity 14 inches away from the diffuser shall not exceed 70 feet/minute. Airflow into the cab shall be manually adjustable and capable of being shut off.

2.7.4 Air Conditioning

The installed refrigeration capacity shall be sufficient to meet the following requirements with an ambient temperature of 87 °F dry bulb/ 72 °F wet bulb:

(a) Maintain the mean interior temperature at 75 °F and relative humidity at 60% or less

(b) Cool down the passenger compartment within 45 minutes after soaking at the specified ambient condition.

The air conditioning shall remain operational, providing the full cooling capacity in outside ambient temperatures of up to 100 °F.

2.7.5 Temperature Control

The HVAC system shall be automatically controlled to maintain the desired interior temperature to manually adjustable set points. When the outside ambient temperature drops below 0 °F, the temperature control shall call for full heating. Similarly, when the outside ambient temperature rises above 87 °F, the temperature control shall call for full cooling. The response and accuracy of the HVAC controls shall be sufficient to maintain the recirculating air temperature variations to within ± 4 °F of the average.

Layover heating shall be automatically controlled by a layover thermostat.

2.7.6 Windshield Defroster/Demister

Defrosting/demisting of the cab windshield and side windows shall be achieved either by provision of a blower and heater assembly or by heating elements within the glass. The defrosting time for the complete surface of the cab front and side windows at an ambient temperature of 10 °F and an inside dew point of 70 °F shall not exceed 15 minutes.

2.7.7 Heater Surfaces

The surface temperature of the heater grilles and enclosures that passengers can touch shall not exceed 125 °F.

Heater elements shall be protected against the following failures:

(a) Failure of the ventilation air flow
(b) Failure of the temperature controls
(c) Short circuit in supply wiring

2.7.8 HVAC Documentation

The Contractor shall submit, for review and approval by the Owner, a Heating, Ventilating and Air Conditioning Performance Report (CDRL), which demonstrates compliance with the requirements of subsection 2.7. This shall include:

(a) Calculation of heating requirements and distribution
(b) . Calculation of air exchange requirements
(c) Calculation of air conditioning requirements and distribution
(d) Analysis of air flow around the passenger area

2.8 Lighting

2.8.1 Interior Lighting Levels

The average intensity of the illumination within the LRT Car, at an elevation of 33 to 66 inches above the floor and on the upper surface of a transverse 45-degree plane at the passenger seat, shall be at least 30 foot-candles at the passenger seats. The average intensity at floor height in the aisles and steps, on the operator's console and in any articulation section shall be at least 20 foot-candles. The minimum light intensity on the door threshold with the doors open shall be at least 2 foot-candles.

2.8.2 Exterior Lighting

Headlights, brake, tail, turn signal, clearance and marker lights, and reflectors shall be supplied in accordance with the New Jersey Department of Transportation, Title 39: Motor Vehicles and Traffic Regulations.

2.8.3 Emergency Lighting

Following the loss of all primary power, emergency lighting shall be powered by the battery. At a minimum, the following lights shall remain functional under emergency power conditions:

(a) Other main interior lights such that the minimum illumination level measured at floor level is 1 foot-candle
(b) All stepwell lights and door area lights
(c) Operator cab lights
(d) Indicator lights

(a) Marker lights
(b) Tail lights / Hazard lights

2.9 Battery Capacity

The battery shall have sufficient capacity to sustain emergency electrical loads for at least 1 hour at 0 °F. Emergency electrical loads shall include:

(a) Emergency lighting as defined in subsection 2.8.3
(b) Radio voice communications
(c) Passenger emergency intercom
(d) Public address system
(e) Door controls
(f) Propulsion and brake controls
(g) Operator's console indicators, lighting and interlocks
(h) Coupler control
(i) Horn and bell

The design of battery installation and circuitry shall include:

(a) Minimal use of organic materials, particularly those having hygroscopic properties.
(b) Battery chargers giving protection against overcharging.
(c) isolation of battery compartment from LRT Car interior.
(d) Battery cases located away from any combustible materials and from other LRT Car equipment which produce high temperatures.
(e) Monitoring of over temperature conditions.
(f) Vent cap to permit gas to escape from battery container

The Contractor shall submit, for review and approval by the Owner, a Battery Load Calculation (CDRL), which demonstrates that the capacity of the batteries is sufficient for compliance with the requirements of this subsection.

2.10 Propulsion System

2.10.1 Engine Fuel Cut-Off

The LRT Car shall be equipped with a safety cut-off device directly on the fuel line to the diesel engine which meets the requirements stated within 49 CFR: Transportation, part 229.93, subpart C: Internal Combustion Equipment, Safety Cut-off Device.

2.10.2 Fuel Tank

A full safety review of the fuel tanks and systems shall be carried out by the Contractor, to demonstrate to the satisfaction of the Owner that the design is safe, and meets appropriate sections of Federal requirements as set forth in 49 CFR: Transportation, Part 393, subpart E: Fuel Systems.

The fuel tanks and filler pipes shall be protected from the passenger compartment by fire barrier material, and shall be properly insulated to prevent fire danger. The fuel tank shall be constructed and located in a manner that will permit filling and draining from the outside of the vehicle only. Filler pipes shall be equipped to complement filler hoses fitted with dry-break mechanical interlocks, as specified in **Part B, Section 10.3.1.2, Car Fueling.**

The fuel tank capacity shall be sufficient to allow **a** LRT Car to run **a** minimum of one full weekday **in** normal revenue service without requiring refueling.

2.10.3 Engine Exhaust

Diesel engine exhaust shall be directed away from all HVAC fresh air intakes, platforms, and sidewalk edges-in street running sections; and·anywhere passengers may be waiting for the LRT Cars.

2.10.4 Engine Emissions

The LRT Car engines shall meet the following emission levels:

Element	Horsepower Range of 175 to 425 hp	Horsepower Range of 426 to 825 hp
Nitrous Oxides (No,)	4.0	6.9
Carbon Monoxide (CO)	3.7	3.7
Hydrocarbons (HC)	1.3	1.0
Particulate Matter (PT)	0.1	0.4
Test Methodology	EPA Heavy Duty Highway Engines 40 CFR parts 9 & 86	EPA Non-road Engines 40 CFR parts 9 & 89

Note: all units are in g/bhp-hr

The Contractor shall submit, for review and approval by the Owner, an Engine Emission Test Report (CDRL), which demonstrates compliance with the requirements of this subsection, either by testing on engines, or by application of previous test results.

2.11 Truck Assemblies

2.11 .1 Structural Integrity

The Contractor shall analyze the static and fatigue strength of the truck frame, bolster (if used), equipment mounting brackets, and axles to demonstrate the structural integrity of the design. The analysis shall show the predicted and design static and dynamic loads, calculated stresses, allowable stresses, and margins of safety for all elements and all specified loading conditions. The design loads shall be estimated from track tests, suitably adjusted to account for the proposed track quality, or derived from an agreed standard(s).

The Contractor shall test the truck frame and bolster to demonstrate their static and fatigue strength over at least 2 million cycles under the action of representative approved dynamic load spectra.

2.11.2 Suspension System

Using a validated mathematical model, the Contractor shall analyze the quasi-static and dynamic behavior of the LRT Car to demonstrate good ride characteristics plus stability, curving and safety against derailment.

The suspension system shall be designed to control the movement of the LRT Car in the three axes of motion and restrict the transmission of noise and vibration to the carbody.

Under any static and/or dynamic condition, the minimum clearances between the truck frame and the track-shall be 2 inches.

2.11.3 Hub Odometer

A hub odometer. registering the total .miles of.operation shall be .installed on at.least one truck per LRT Car.

2.11.4 Truck Assembly Documentation

The Contractor shall submit, for review and approval by the Owner, a Truck Assembly Finite Element Analysis Report (CDRL), which demonstrates compliance with the requirements of subsection 2.11.1, and details the predicted and designed static and dynamic loads, and the margins of safety for the truck frame, bolster and axle.

The Contractor shall submit, for review and approval by the Owner, a Suspension Behavior Calculation (CDRL), detailing the findings of the analysis required in subsection 2.11.2.

2.12 Braking

2.12.1 Service Braking Method

The primary service brake shall be dynamic braking. The friction braking method shall be of the "energize to release", self-maintaining fail-safe type to ensure passenger safety in all possible situations.

Activation of service braking shall be initiated by any of the following:

(a) the operator through selecting a Master Controller Service Brake position
(b) emergency manual release lever is activated at any doorway on the LRT Car
(c) disruption of the door lock mechanism safety circuit (e.g. a door opens)

The fail-safe spring applied friction brakes also shall be used for parking.

2.12.2 Emergency Braking Method

Emergency braking shall be achieved by at least two fail-safe independent methods.

Activation of the emergency brake shall be initiated by any of the following:

(a) the operator using the console-mounted emergency push-button
(b) the operator selecting the master controller Emergency Brake position
(c) separation of an LRT Car from a consist
(d) the enforced stop device is activated

The emergency brake system shall override all requested acceleration and deceleration rate commands and shall not be capable of being reset until the zero speed signal is detected.

2.12.3 Enforced Stop Devices

As specified in **Part C, Section 3.11,** enforced stop devices shall be installed along the track, and there shall be detection of these by the LRT Car. Activation of this device shall send a signal to the brake system to command an emergency brake application.

A momentary contact override button shall be provided in each cab accessible from the driving position, to enable the operator to pass an enforced stop device under instruction from the Control Center. A cut-out switch shall be provided in each cab, not accessible from the driving position, to **enable** the operator to disable the LRT Car-borne enforced stop system, under instruction from **the Control** Center. Operation of either the override button or the cut-out switch shall be recorded by the event recorder.

2.12.4 Brake Duty Cycle

The brake'system shall be capable of safely stopping the LRT Car under the following operations:

(a) Continuous round-trip, normal operation of a consist under an AW3 load condition on the specified route, observing all speed restrictions, and stopping at all route stops. For rating purposes, dwell time at each stop shall be 20 seconds and end turn-around time shall be 120 seconds.

(b) Emergency operation of an LRT Car consist with the brake system available only on 50% of the LRT Cars shall not exceed a speed of 25 miles per hour. The consist shall be able to move to the next stop to evacuate passengers. Then, observing the 25 mph speed restriction, the consist shall be able to return to the maintenance facility from any point on the alignment.

Calculation of the capacity to achieve these duties shall be included in the LRT Car Performance Report, specified in section 2.2.5, and verified during LRT Car testing, and friction brake dynamometer testing. The Owner will accept previous test results if they were performed with the identical car configuration and they were witnessed by an independent third party.

2.12.5 Sanding System

The sanding system shall, as a minimum, deliver sand to the leading wheels on all motor trucks in each direction of travel. All components of the sanding system shall be designed to be waterproof and designed to prevent clogging. Sanding shall be automatically activated during emergency braking and upon detection of wheel slip-slide condition. The cab console shall be provided with a momentary toggle button, for sand application by the operator.

2.13 Communications

2.13.1 Public Address System

An on-board Public Address (PA) system shall be provided. The PA system shall comply with ADA requirements to transmit routine audio and visual announcements and emergency warning information from the LRT Car operator to the passengers. All audio announcements shall be intelligible above ambient noise and shall be acoustically pleasing under all operating conditions. Visual displays shall be visible from all locations within the LRT Car. The PA subsystem shall also provide pre-recorded voice announcements and visual displays automatically or operator-initiated, including:

- Next station
- Station arrival

A recording capability with the ability to create and modify pre-recorded messages shall be provided.

Exterior destination displays shall be provided on the LRT Car. One display shall be mounted at each end and at least one on each side. The signs shall be controlled from the active cab by commands transmitted through trainlines.

2.13.2 Passenger Emergency Intercom

Passenger emergency intercom stations shall be provided to support voice communications between passengers and the operator. The passenger emergency intercom stations shall be located such that they are easily accessible to all passengers. There shall be a minimum of one station per passenger compartment, plus one located in each wheelchair location.

2.13.3 Qperator's Radio

Radio voice communication shall be provided for communication between the operator and the Control Center, as specified in **Part C, Section** 5.2. A silent alarm capability shall be provided as specified in **Part C, Section 5.2.** This alarm shall also trigger a help message on the LRT Car exterior destination displays.

2.13.4 Video Recorder

The LRT car shall be provided with wiring and circuit protection for a future installation of a digital video system. The number of video camera locations and the location of the recorder shall be proposed by the Contractor and approved by the Owner.

2.14 Documentation

In addition to the documents defined elsewhere in this section, the Contractor shall, during the D/B phase, submit for review and approval, the following documentation as CDRL items:

(a) Test schedules, test specifications and test reports for each major component
- Test schedules (CDRL) shall be submitted at least 120 days before the first test.
- Test specifications (CDRL) shall be submitted at least 60 days before the test.
- Test reports (CDRL) shall be submitted not later than 30 days after the test.

(b) Final design drawings, shall include:
- i. General arrangement of the carbody (CDRL), showing top, side and end views. Detail shall include the seating layout, position of stanchions and grabrails, window size, exterior lighting arrangement, lifting and jacking points.
- ii. Operator's cab layout (CDRL), including all instrumentation.
- iii. Carbody swept envelope (CDRL) for the minimum horizontal curve radius.
- iv. Carbody dynamic envelope (CDRL).

Exhibit F

FTA Letter to NJDOT Confirming Compliance with 49 CFR 659

U.S. Department of Transportation
Federal Transit Administration

Headquarters

400 Seventh St., S.W.
Washington D.C. 20590

JUN 1 5 1998

Mr. Theodore H. Matthews
Acting Executive Director
Aeronautics and Freight Systems
New Jersey Department of Transportation
CN 600
Trenton, NJ 08625

Subject: **Federal Transit Administration's State Safety Oversight Program: Compliance Status of New Jersey**

Dear Mr. Matthews:

The Federal Transit Administration has received the 1997 Annual Report and the 1998 Certification of Compliance submitted by the Yew Jersey Department of Transportation, two documents that are required under 39 CFR 659, the State Safety Oversight Program for Rail Fixed Guideway Systems. We have reviewed these documents and found them to be satisfactory

We appreciate your continuing efforts to implement the State Safety Oversight Program in New Jersey. If you have any questions, you may call Mr. Roy Field at (202) 366-0197.

Sincerely,

Hiram J. Walker

Hiram J. Walker
Associate Administrator
Office of Program Management

JUN 19 1998

Exhibit G

NJ DOT System Safety Program Standard

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SYSTEM SAFETY PROGRAM STANDARDS

STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
November 5. 1997
[illegible]

STATE SAFETY
OVERSIGHT OF FIXED GUIDEWAY SYSTEMS
SYSTEM SAFETY PROGRAM STANDARDS

Title 27:1A and Executive Order No. 65 (1997) requires the New Jersey Department of Transportation(NJDOT) to oversee the safety of rail fixed guideway systems. The NJDOT has promulgated standards that the operating fixed guideway systems must meet. The safety oversight system safety program standards are as follows.

I. **GENERAL PROVISIONS**

This section describes the policy statement and identifies the statutes that empower the transit agency to conduct its duties.

II. **DEFINITIONS** (Refer to Rule)

III. **REQUIREMENTS FOR SYSTEM SAFETY PROGRAMS PLAN**

This section sets forth the **SYSTEM SAFETY PROGRAM STANDARDS** (minimum requirements) that must be included in each operational fixed guideway system safety program plan. The basic requirement for each system safety program is to develop a system safety program plan that complies with the **STATE OF NEW JERSEY SYSTEM SAFETY PROGRAM STANDARDS (STANDARDS)** set forth herein and the above referenced documents. The plan must address both safety and security. The system safety program must set forth the authority that created the transit agency and a policy statement, endorsed by upper management, that embraces system safety. In addition each plan must describe the controls that will be used to maintain communications and liaison with the NJ DOT.

- Each plan must be submitted to the NJDOT for review and approval. The NJDOT will perform an initial review and resolve any comments. Following the revien, there will be a resolution of any comments through informal discussions with the respective transit agencies. A resolution or other order will be issued by the NJDOT granting formal approval of a system safety plan.

- The NJDOT will conduct a formal on-site review at each transit agency once every three years to evaluate the effectiveness of the agency's implementation of its system safety program plan(SSPP). The NJDOT will prepare and submit a draft report to the transit agency for each triennial review. A working session will be arranged to discuss the findings of non compliance with the **SSPP**. Following the working session, a response will be included in the final report.

IV. **REQUIREMENTS FOR INTERNAL SAFETY AUDITS**

As established by these standards, this section requires each transit agency to conduct internal audits to evaluate compliance with the **SSPP** and measure its effectiveness. A report covering the audits performed during the preceding year must be prepared by each transit agency and submitted to the NJDOT by the 1"' of August each year.

V. **REQUIREMENTS FOR REPORTING ACCIDENTS AND UNACCEPTABLE HAZARDOUS CONDITIONS**

This section establishes the requirements for reporting accidents, incidents, and unacceptable hazardous conditions. Unless the NTSB has investigated or will investigate, 'the NJDOT must investigate accidents and unacceptable hazardous conditions occurring at rail transit agencies under its jurisdiction. Unacceptable incidents and hazardous conditions as well as accidents must be reported to the NJDOT.

VI. **REQUIREMENTS FOR INVESTIGATING ACCIDENTS AND UNACCEPTABLE HAZARDOUS CONDITIONS**

This section establishes the requirements for investigating accidents, incidents, and unacceptable hazardous conditions. In certain instances investigations may be performed by the transit agency. The NJDOT will oversee the investigations and review each investigation report to confirm that the appropriate corrective action plan and schedule have been prepared to prevent a recurrence of the accident or unacceptable hazardous condition.

■ SYSTEM SAFETY PROGRAM STANDARDS

FOR THE ESTABLISHMENT OF SYSTEM SAFE-l-Y
PROGRAM PLANS FOR FIXED GUIDEWAY SYSTEMS

1. **GENERAL PROVISIONS - SYSTEM SAFETY PROGRAM**

This section describes the policy statement and identifies the statutes that empower the transit agency to conduct its duties.

1.1 Policy Statement

The highest levels of transit agency management must set forth its policy. embracing safety and security('). The appropriate management approval shall be denoted by signature on the policy statement and circulation of the statement to all departments. As part of this section, top management is to provide direction to the transit agency for the development of a System Safety Program that will encompass the transit agency policy statement in all facets of its operations.

1.2 Authority

- The appropriate statute(s), regulations or pending legislation related to the extension of powers and duties of the transit agency to improve and protect public safety shall be identified.

2. **FORMATION OF THE TRANSIT AGENCY AND ITS PURPOSE.**

2.1 Precepts of the Transit Agency

- Describe the body empowered to develop the fixed guideway system by its legal name including any authorizing and implementing legislation that may have been required to establish that body.

(1) denotes security component of the system safety program that must be included by January 1, 1998.

- Include State statutes and municipal codes enacted to establish the agency as the legally recognized body. In the event areas served have multiple jurisdictions, define the interface responsibilities among these jurisdictions.

2.2 Description of Purpose

- Include a statement of purpose. (An example - the system safety program plan was prepared to show how the program fulfills the directives of the Policy Statement).

- Define the intent of the System Safety Program Plan. Emphasize that the development of the System Safety Program is to comply with policy directives and to integrate safety and security with all facets of the transit agency functions.

- Summarize how the plan establishes the safety philosophy of the transit agency and the means for implementing its philosophy during operations. The System Safety Program Plan shall include the following:

  .1) The safety and security program and its means of enforcement on a system wide basis.

  .2) The medium through which the transit agency can display its commitment to safety security and

  .3) The framework for the Plan's implementation of policies and achievement of goals and objectives.

  .4) How federal and state requirements are to be satisfied.

  .5) How industry accepted standards are achieved.

- Clearly define how system safety and security are manifested throughout the operational aspects of a transit agency.

- Specify all system safety program plan (SSPP) definitions applicable to the operating system.

3 GOALS

Specify system safety and security goals in accordance with the following guidance:

- The goal must be <u>long term</u>. The goal must have broad and continuing relevance throughout the transit agency's operational life..

- The goal must not be so broad as to be meaningless; specific desired results should be identified.

An example of relevance might be:

A goal that states " to establish and maintain a high level of safety comparable to other fised guideway systems in the U.S." ---In this example the goal is long term, qualitative, and realizable.

Other esamples:

Identify, eliminate, minimize, and/or control all safety hazards.

Provide appropriate actions and measures to obtain necessary safety-related agreements, permits, and approvals from outside agencies, where applicable.

4 OBJECTIVES

Objectives of the SSPP shall be identified and describe the means of achieving the identified goals. The objectives must be quantifiable. They must be meaningful to provide a framework for the day to day activities for safe and secure operations. Objectives can be expressed as a series of policy statements issued by the transit agency management.

In specifying policies, the following are guidance to the transit agency:

- The Policies must set the framework for guiding the safety and security program, on a long-term basis.

- The Policies should be achievable

- The Policies are the method for reaching a specific objective(s), e.g.,
  A safety policy can be stated to establish a safety program with security provisions incorporating public: patron, employee: and property safety, including fire protection. loss prevention, and life safety requirements.

  Any policy developed by the transit agency should be related to the goals and objectives and its system safety and security philosophy.

5. SYSTEM **DESCRIPTION/ORGANIZATION**

5.1 System Description

Describe the particular characteristics of the transit system. Include a graphical representation depicting the service area and location of facilities. Present the information in a manner that permits nontechnical and non transit persons to understand the system and its basic operations; include, as a minimum, the following elements in the System Description:

5.1.1 Historical Background

Include a chronology of key events in the fixed guideway system and a general overview of the transit system.

5.1.2 Scope of Service

Describe the planned services and general operating characteristics of the fixed guideway system.

5.1.3 Physical Plant - Description, Safety Inspections and Maintenance Programs

Provide a description of the fixed facilities and include the regular cycle of inspections and maintenance programs for the safety-related facilities and equipment, listing which items are to be inspected. Include:

- The fixed guideway system including a description of aerial, at-grade and subway segments and joint railroad-fixed guideway common corridor operations .

- Information pertaining to the number and types of vehicles and other data to sufficiently identify the technical differences within the fleet.

- The maintenance facilities and storage yards and their respective locations.

- The built-in safety capabilities such as fire suppression systems, emergency ventilation, emergency communications equipment, passenger communication equipment (visual and audio), and flammable storage shelters, etc.

  Include a description of how identified hazards are entered into the hazard resolution process.

5. .4 Operations

Provide a general description of the type of operation and controls for the conduct of operation. Elements to be included are: emergency and disaster contingency. plans and training procedures, operating rules and operational procedures

5.1.4.1 Operations - Schedules, Headway and Recovery

Provide a general description of operating schedules. with approximate headways, dwell times and consist sizes. Include methods of vehicle control, and procedures for selecting the methods to be used at any particular time in the operating schedule. Emphasize specific failure recovery philosophies for cases such as: extended service delays/interruptions, major system shut-down/delays, and/or prolonged service outage due to modernization or construction.

5.1.4.2 Emergency Response Planning, Coordination, and Training

Describe the emergency response plan and procedures. As part of the plan, the transit agency must include a list of outside emergency response agencies, a means to coordinate/communicate with the agencies, and emergency drills. Emergency drills can be simulated emergency conditions (mock-drills), table top exercises, walk through or specific emergency. response training sessions.

5.1.4.3 Rules and Procedures Revien

Define the processes and controls used by the operation and maintenance units to ensure that rules and procedures are carefully. developed, maintained, and followed.

5.1.4.4 Training, Certification Review and Audit

Describe the training, retraining: certification, and recertification program (including frequency) for employees in safety- related positions. The transit agency must maintain a permanent file of personnel training records.

5.1.4.5 System Data Acquisition, Analysis and Follow-up

Include a description of how the transit agency collects: distributes and analyzes safety data to determine trends or patterns in system operation. The process should be integrated with the hazard resolution process. Describe the procedures used to monitor and follow-up action items until there is a resolution and the action item is closed.

5.1.4.6 Public Awareness Program

Describe the program that is used to promote and educate the general public, system passengers and employees of operational and or construction safety and security matters, tips, ideas, instructions and other information for the general welfare of the public.

5.1.5 Maintenance

In this section provide a description of the maintenance process and practices. Include the controls over equipment manuals, shop/site specific procedures, maintenance records: parts and materials, tracking/ resolving of problems identified during inspections, the lack of required maintenance, and the following:

- the purpose and use of scheduled maintenance for all equipment.
- maintenance tasks performed by the transit agency personnel and tasks performed by outside contractors.
- Maintenance philosophy, scheduled maintenance activities, and provisions for corrective maintenance and emergency repairs are to be included (Place emphasis on any special maintenance practices, rules and procedures used for safety critical equipment).
- Identify rules and procedures for assuring that vehicles are safe for use in revenue service.

5.1.5.1 Training and Certification

Provide categories of safety-related work requiring training and certification.

Describe the training, retraining, certification, and re certification program (including frequency) for employees in safety. and security-related positions. The transit agency must maintain a permanent file of personnel training records.

5.1.5.2 Maintenance Inspections and Tests

Inspections and tests should be performed on operating equipment and facilities after each preventative or corrective maintenance action. Additionally, periodic inspections and /or tests should be performed at regularly scheduled intervals to provide a reasonable degree of assurance that equipment and facilities are safe for operations. These inspections/tests should be performed as a minimum using the appropriate checklist as follows:

- PCC Car / Light Pail Vehicle Inspection
- Heavy Rail Vehicle
- Elevator / Escalator
- Fixed Facilities Including Stations / Shelter Stops, Bridges, Passage ways, and Other Structures.
- Monorail Vehicle
- Automated Guideway(People Mover)
- Track System and Right of Way
- Wayside (Signals/Communications/Traction Power&Substations)
- Fire Protection / Suppression System
- Guideway / Non-Guideway Support Vehicles

Describe the program for acceptance testing and inspections for all equipment and facilities furnished to the transit agency for operations.

5.1.6 System Modification

Provide an overview of the manner in which safety and security is assured in connection with modifications and changes to the system. Include the following:

- the process for system modification.
- how changes are developed, implemented, documented, and evaluated for their impact on the safety and security of systems elements and the overall system.
- the lines of authority, levels of responsibility, and internal and external organizational interfaces during the change process.

Both capital and operating programs are to be included in the change process and must address both hardware and software elements.

5.2 Organizational Structure

Show the lines of authority and responsibility for operations, maintenance, and engineering as they relate to system safety, including security. Provide the following information:

5.2.1 Detailed organizational diagrams with a title of each position

5.2.2 Detailed diagrams of the structure of the system safety and security unit identifying levels and key positions.

5.2.3 Diagrams showing the relationship and lines of communications between the system safety unit and other units of the organization.

5.2.4 The relationship of the transit system to political jurisdictions through which the fixed guideway operates

6. SYSTEM SAFETY PROGRAM PLAN CONTROLS AND UPDATE PROCEDURES

The system safety program plan including provisions for security will require updates or modifications according to changes in software or hardware. State in this section the frequency, either by demand or at selected intervals, for review and update of the plan. Include a description of the steps required for developing and issuing changes.

Upper management must review and approve all changes in goals, objectives or redirection of policies.

7. HAZARD IDENTIFICATION / RESOLUTION PROCESS

Each transit agency shall investigate all unacceptable hazardous conditions on behalf of the NJ DOT. The NJDOT may also perform separate, independent investigations at its own discretion.

This section is to include how the transit agency will identify and document hazards occurring in operations, maintenance, and engineering. It must include the process by which hazards are categorized, analyzed, and resolved for operations, maintenance, and engineering. The process must be accessible to all levels of the organization, include analysis for potential impact on the operating system, and include a means of resolution acceptable to management. A Hazard Resolution Process must consist of three primary components:

- ♦ HAZARD IDENTIFICATION
- ♦ HAZARD CATEGORIZATION
- ♦ HAZARD RESOLUTION

7.1 Hazard Identification

Describe the methods used to insure that the maximum number of hazards are identified and entered into the Hazard Resolution Process. These methods may include such exercises as Preliminary Hazard Analysis (PHA), Operating Hazard Analysis **(OHA),** Critical/Catastrophic Items List (CCIL), Fault Tree Analysis, Subsystem Interface Analysis, various Human Factors Analysis and Joint Railroad - Fixed **Guideway** Corridor Operations .

New systems, with no history to analyze the operations, must include the necessary hazard analysis into both design consulting and procurement contracts.

Systems that have operated over a period of years may elect to use the input of operations and maintenance personnel as sufficient for the hazard analysis process. In both cases the process must be formal enough to sufficiently document a procedure with appropriate sign-offs and checks and balances. The process must be available to all units of the organization reviewed and administered on a routine basis, and have high level visibility and participation. Hazard Identification is an ongoing process, viable throughout the system life cycle. Accidents and incidents, resulting from previously unidentified hazards, must enter the Hazard Resolution Process.

7.2 Hazard Categorization

The following sections represent a methodology. adopted from the Military. Standards and used for determining which hazards are acceptable, acceptable with certain conditions applied, and unacceptable.

It is extremely important to design <u>in advance</u> a process for handling exceptions to the established procedure, as anticipating every situation is virtually impossible.

A method of categorizing all identified hazards must be included.

7.2.1. Hazard Severity (MIL-STD 882C) - is a subjective measure of the worst credible mishap resulting from personnel error, environmental conditions, design inadequacies, and/or procedural efficiencies for system, subsystem: or component failure or malfunction, categorized as follows:

7.2.1.1 I (Catastrophic) -	Death or system loss
7.2.1.2 II (Critical) -	Severe injury, severe occupational illness, or major system damage

7.2.1.3 III (Marginal) - Minor injury, minor occupational illness, or minor system damage

7.2.1.4 IV (Negligible) - Less than minor injury, occupational illness, or system damage

7.2.2 Hazard Probability (MIL-STD 882C) - is the probability that a specific hazard will occur during the planned life expectancy of the system element, subsystem, or component. It can be described subjectively in potential occurrences per unit, events, population, items, or activity, ranked as follows:

7.2.2.1 A (Frequent) - Likely to occur frequently (individual); Continuously experienced in fleet/inventory

7.2.2.2 B (Probable) - Will occur several times in life of an item; will occur frequently in fleet inventory

7.2.2.3 C (Occasional) - Likely to occur sometime in the life of an item; will occur several times in fleet/inventory

7.2.2.4 D (Remote) - Unlikely but possible to occur in life of an item; unlikely but it can be expected to occur in fleet/ inventory

7.2.2.5 E (Improbable) - So unlikely, it can be assumed the occurrence may not be experienced; unlikely to occur, but possible in fleet/inventory

Once a hazard is identified: an analysis as to its potential severity, and probability. of occurrence is performed. The transit agency must standardize the process for this analysis and document the approved procedure. They must follow this procedure as prescribed. While developing qualitative methodology for this type of analysis is possible, the most practical method for fixed guideway transit application is simple deductive reasoning, applied on a collective, or organizational basis. The composite management staff of all key line and staff departments, administered by the safety unit, can effectively determine the severity of all but the most difficult or unusual hazards.

It is important.. however, to determine in advance the exact mechanism for implementation of this process. Also, an administrative appeal process must be included, should a consensus on categorizing a specific hazard prove too difficult to achieve. A mechanism, for outside assistance, should be provided.

Hazards identified on an ongoing basis must enter ‘the formal process, the same as those identified by formal analyses techniques associated with new procurement and new system construction. All employees involved in the hazard identification process should know and understand their respective roles.

7.3 Hazard Resolution

Hazard Resolution is the analysis and subsequent actions to reduce to the lowest level practical, the risk associated with an identified hazard. Hazard Resolution is not synonymous with hazard elimination. In fixed guideway systems environment, there are some hazards that are impossible to eliminate and others that are highly impractical to eliminate. Using protective and warning devices or special procedures are ways to consider a reduction of risk. Some hazards present unacceptable risks because of severity and high probability. These hazards must be eliminated.

Part of the Hazard resolution procedure is a predetermined matrix prescribing which identified hazards are acceptable, acceptable with mitigation, and unacceptable. Once this matrix is defined by the transit agency, deviation from the prescribed resolution process should occur only through approved, predetermined channels. A sample of a Hazard Resolution Matrix is provided in figure 7.3.1 for use by the transit agency.

7.4 Safety Oversight Agency - Incident Reporting - Transit Agency Reports

A formal policy must be established clearly identifying which incidents will be investigated. As part of the policy, the transit agency shall define the thresholds for automatic activation of an investigation; guidelines on whether incidents should be investigated immediately or after the fact; and guidelines on who is in charge of each specific level of investigation. The transit agency shall submit written incident investigation reports for review and concurrence. The reports shall include information of the most probable cause, other contributing causes, corrective action plans, and schedule for implementing action.

Hazard Resolution Matrix				
	Catastrophic	***Critical***	***Marginal***	***Negligible***
Frequent	UNACCEPTABLE	UNACCEPTABLE	UNACCEPTABLE	***Acceptable(WR1)***
Probable	UNACCEPTABLE	UNACCEPTABLE	UNDESIRABLE	***Acceptable(WR1)***
Occasional	UNACCEPTABLE	UNDESIRABLE	UNDESIRABLE	***ACCEPTABLE***
Remote	UNDESIRABLE	UNDESIRABLE	***Acceptable(WR1)***	*ACCEPTABLE*
Improbable	***Acceptable(WR1)***	***Acceptable(WR1)***	***Acceptable(WR1)***	***ACCEPTABLE***
Acceptable(WR1)-- ACCEPTABLE with review by management staff				

Figure **7.3.1**

8. ACCIDENT/INCIDENT REPORTING AND INVESTIGATION REQUIREMENTS

Each transit agency shall investigate all reportable accidents on behalf of the NJ DOT. The NJDOT may also conduct separate, independent investigations at its own discretion.

When the transit agency's investigation involves post accident inspections, examinations and testing, the NJDOT shall be notified so that it may participate in the investigation.

The transit agency's investigation shall be documented in a written report that identifies the most probable cause and other contributing causes of the accident or unacceptable hazardous condition. The report shall also contain or reference a corrective action plan and schedule to prevent a recurrence of the accident: or to mitigate the unacceptable hazardous condition.

Accident and incident investigations are related to the Hazard Resolution process in that feedback and follow-up from these investigations are to be automatically entered into the Hazard resolution process. It is virtually impossible to anticipate all hazards before they cause an accident or incident, however: once an incident occurs, the transit agency safety entity must take the necessary actions to prevent a recurrence.

8.1 Criteria

A formal policy must be established clearly identifying which accidents/incidents will be investigated. As part of the policy, the transit agency shall define the thresholds for automatic activation of an investigation; guidelines on whether incidents should be investigated immediately or after the fact; and guidelines on who is in charge of each specific level of investigation.

8.2 Accident and Unacceptable Hazardous Conditions Reporting Requirements.

8.2.1 Each transit agency shall submit accident/ incident reports to the NJDOT. Reportable accidents/incidents are those which exceed the thresholds defined in Sections 7 and 8. Immediate notification to the NJDOT shall take place if the occurrence falls into the category of 8.7.1.1 .a), 8.7.1.1 .b), and/or X.7.1.1 .c). The immediate notification shall be by telephone, telefax, or other NJDOT approved electronic media.

8.2.2 Each transit agency shall submit written accident and unacceptable hazardous condition reports on standard forms (to be determined). Such written reports must be submitted within 30 days after the last day of the month in which the accident occurred or the unacceptable hazardous condition was discovered. By-weekly Interim reports shall be submitted to NJDOT for all reports not submitted within 30 days from the date of the event. Reports shall contain the most probable cause: other contributing causes: corrective action plans, and schedule for implementing corrective action. Written reports shall be filed for all occurrences that fall into the category of 8.7.1.1.a), 8.7.1.1.b), and/or 8.7.1.1.c) or as defined in 8.2.3.

8.2.3 Each transit agency shall file a monthly statement of all accidents, and unacceptable hazardous conditions. In addition, an annual safety performance report shall be filed in a format as determined by the NJDOT.

8.3 Procedures/Reporting/Follow - up

Describe the procedures used for performing investigations, including the reporting of findings, conclusions reached, corrective action recommendations, and follow - up to verify corrective action implementation.

8.4 Internal Notification

Include a list of personnel, in priority order, that are to be notified when there is an occurrence (accident or incident).

8.5 Documentation

All necessary information pertaining to a specific occurrence must be documented in a standard format and available upon request. The documentation must include any required training or retraining (in the event of human error or procedural error).

8.6 External Notification

Include a list of all agencies that are notified when there is an occurrence (accident or incident). This list should include the NTSB. NJDOT, any local regulatory agencies, and others as required according to statutes or separate agreements.

8.7 State Safety Oversight Agency Accident Investigation

Under the FTA Final Rule 49 CFR Part 659, a State oversight investigation is required only for the occurrence of an accident/incident that exceeds the thresholds established in 8.7.1 (Definitions) that are associated with the operations and maintenance of fixed guideway vehicles. other on-track/guideway equipment, signal systems, traction power systems. or maintenance of track/guideway and other wayside equipment.

8.7.1 Definitions:

8.7.1.1 Injury, Fatality, Property Damage, and Hazardous Condition.

.a) Accident

Means any occurrence on a fixed guideway system that involves a collision between guideway vehicles or other on-guideway equipment or motor vehicles, derailment, explosion, fire or any other loss causing event during operation (excluding yard operations) of such fixed guideway system that results in a fatality. to a passenger. pedestrian/other persons, employee: or the emergency. evacuation of persons.

.b) Incident

Means any unforseen event or occurrence which presents a hazardous condition, but does not necessarily result in injury. or property damage.

.c) Injury

Means medical attention to a passenger, employee or other person that requires transport to a medical facility by-ambulance or police vehicle for medical treatment.

.d) Property Damage

Means (1) damage, based on a preliminary gross estimate of $100,000 or more for repairs, or current replacement cost, to fixed guideway and non-fixed guideway property, or (2) damage of $25,000 or more to a passenger carrying fixed guideway train and fixed guideway and non-fixed guideway property.

8.7.1.2 **APTA** Guidelines

The American Public Transit Association's "Manual for the Development of Rail Transit System Safety Program Plans," published on August 20, 1991.

8.7.1.3 Fixed **Guideway** System
Same as Rail Fixed Guideway System

8.7.1.4 Hazardous Condition
A condition that may endanger human life or property. It includes unacceptable hazardous conditions.

8.7.1.5 Rail Fixed **Guideway** System
Any light, heavy, or rapid transit rail system, monorail, inclined plane, funicular: trolley,, or automated guideway that is:

.1) included in the FTA's calculation of fixed guideway route miles or receives funding under FTA's formula program for urbanized areas (49 U.S.C. 5336); and

.2) not regulated by the Federal Railroad Administration

8.7.1.6 Safety
Freedom from danger.

8.7.1.7 **Security**
Freedom from intentional danger.

8.7.1.8 System Safety Program Plan
A document, adopted by the transit agency, detailing its safety. policies, objectives, responsibilities, and procedures.

8.7.1.9 Transit Agency
An entity operating a rail fixed guideway system

8.7.1.10 Unacceptable Hazardous Condition
A hazardous condition determined to bc an unacceptable hazardous condition using the APTA Guidelines' Hazard Resolution Matrix (APTA Guidelines, Checklist number 7).

9. SECURITY

The transit agency's security* program must emphasize the importance of identifying potential threats and areas of vulnerability.. Describe the security plan including the following:

* the security* roles of each person and department
* the functions of each person and department
* a list of milestones for developing and implementing the program
* the use of contract services and/or external support units (if any)

Provide organizational diagrams showing the relationship between security and other departments. Identify the structure of the organization, identify key positions and responsibilities and show titles of other positions.

Note: Additional information will be issued regarding standards for the development of a security program plan to meet the date as set forth in the FTA 's Final Rule.

9.1 GENERAL

Pail Fixed Guideway Systems are vulnerable to certain types of crimes, including vandalism and graffiti, pick-pocketing and purse snatching: fare avoidance, trespassing. and other security-related problems which must be eliminated or minimized. It is therefore necessary to identify these security threats and reduce vulnerability to them.

To emphasize the importance of security in all aspects of a Fixed Guideway Transportation System a set of comprehensive security activities should be established and documented in the System Safety Program Plan. The overall goal of the security program should be to maximize the level of security afforded to passengers, employees and property.

To be effective: the security aspects of the System Safety Program Plan (SSPP) should be oriented toward identifying potential security problems and implementing remedial and/or mitigating measures before security problems arise.

It is also important to recognize the sensitivity of security related plans and procedures as they are tactical in nature, and must be treated with a reasonable degree of confidentiality. For this reason, the security elements of the SSPP should identify items which need to be considered, but should not provide specific tactical related information.

9.2 SECURITY PROGRAM IMPLEMENTATION REQUIREMENTS

The operation and maintenance of a Fixed Guideway Transportation System requires continual security activity throughout its operational life, including procurement of new systems, modification and/or rehabilitation of security-critical equipment and facilities.

The folloning security requirements must be identified to provide direction in implementation of the security program. These security tasks must be continually implemented and are considered minimum requirements.

9.2.1 SECURITY ALTERNATIVES

The Fixed Guideway Transportation System has primary responsibility for policing their system in an efficient and cost-effective manner. To this end, alternative approaches to security should be studied to optimize its own security force complimented by Local Police in jurisdictions. Policing should be accomplished by means of any combination of

- Sworn Fixed Guideway Police Officers
- Security Officers
- Patrol Guards
- Administrative Management Staff
- Local Police

9.2.2 SECURITY ASSESSMENT OF THE FIXED GUIDEWAY TRANSPORTATION SYSTEM

A profile of crime conditions that exist in the vicinity of the Fixed Guideway System must be assessed to determine what security provisions must be provided for, given existing crime patterns.

Included in this assessment shall be a review of the following types of security incidents that can occur in the community surrounding Fixed Guideway System:

- assault and battery
- disorderly conduct
- fare evasion
- facility and equipment damage
- parking lot theft
- sale and use of drugs
- graffiti and vandalism
- muggings
- rape
- suicide
- trespassing
- barricaded hostage
- solicitation
- theft, purse snatching
- terrorism
- lewdness
- forgery
- fraud
- exhibitionism
- bomb threats
- sabotage, destruction: altering and fixed guideway-related experience regarding the following internal crimes:
- revenue theft
- computer database intrusion
- sale and/or use of drugs
- alcohol abuse
- facility and equipment damage
- personal crime .
- sabotage, destruction, altering
- stock/parts shrinkage
- breaking and entering
- personal crime

9.2.3 DIVISION OF SECURITY RESPONSIBILITIES

The Fixed Guideway System shall identify its division of security responsibility to establish management of security, the responsibilities of sworn officers, non-sworn officers and/or security guards, and whether security responsibilities are shared with local police.

9.2.4 SECURITY COMMITTEES

The Fised Guideway System shall establish a Proactive Security Committee and a Security Breach Review Committee; the former responsible for identifying and neutralizing security risks; the latter responsible for identifying security issues, investigation of incidents and development of corrective action (countermeasures), Both of these committees should reside within the Fixed Guideway System's Police Department.

9.2.4.1 PROACTIVE SECURITY COMMITTEE

The Proactive Security Committee shall conduct systemwide security assessments and ensure that new procedures and facilities incorporate security in their design. The committee shall also review training curriculum geared to security. Additionally, this committee shall:

- determine compliance with management policies, rules, procedures and assigned security responsibilities.

- identify organizational issues that may contribute to security incidents, or less effective response to incidents.

- actively promote security awareness campaigns and award programs.

Staffing of this committee should be a combination of Fixed Guideway System and local community representatives,

9.2.4.2 SECURITY BREACH REVIEW COMMITTEE

The Security Breach Review Committee shall identify security breaches and investigate these breaches to understand the deficiencies in the security. program. Unlike the Proactive Security Committee, this committee shall focus on incidents that have already happened.

It is acknowledged that the breaches and incidents investigated by this committee are controversial and sensitive. Such incidents may involve violence, criminal activity, or wrong doing by Fixed Guideway System staff. The following security. incidents shall be reviewed to determine whether the breach occurred because of

- incorrect policies or procedures
- staff not following procedures
- an accepted risk unforeseen technology, or action against the Fixed Guideway System

9.2.5 SECURITY TRAINING

Various levels of security training shall be established for Fixed Guideway personnel so that employees can carry out their responsibilities. This training shall vary from police academy training, to sending staff members to national meetings on transit security..

Security shall also be emphasized during employee orientation training.

Professional development training in security shall be provided to key security staff by attendance at a certified academy, pre-employment screening tests, and on-the-job training.

9.2.6 SECURITY OPERATING ACTMTIES

Fised Guideway Police shall identify security-related activities that are carried out on a daily basis, considering all elements of the Fixed Guideway System (environment, people, procedures and property) consisting of

- standard operating procedures
- emergency operating procedures
- security related tasks that are subordinate functions of other Fixed Guideway System related activities

9.2.6.1 STANDARDOPERATINGPROCEDURES

Standard Operating Procedures (SOP's) that are the daily activities intended to accomplish the security-related functions shall be developed (the rules and policies by the fixed Guideway System).both proactive and reactive.

Some representative esamples of activities that have an impact on security are:

- operators leaving vehicles at end of shifts
- securing parking lots and yards
- securing buildings
- building property access
- termination of employment
- collecting, transport and counting of revenue
- securing other vehicles
- securing equipment
- patrolling facilities
- daily security staff activities
- response to potential security breaches and security.-related activities of station attendants and train operators
- train operator procedures forhandling security threats

9.2.6.2 EMERGENCY OPERATING PROCEDURES

Emergency Operating Procedures (EOP's) shall be developed for non-routine but serious occurrences such as response to alarms, critical or catastrophic events, (power failures, natural disasters, etc.).

These EOP's shah include:

- emergency reporting.
- emergency handling by security staff.
- emergency actions by front line staff.

- dispatcher responses,

- Fixed Guideway System actions for minor security incidents, crimes against passengers, violent crime, bomb threats, hostages, terrorism, burglaries, or other specific security breaches.

- incident investigation

- media communications.

- contingency plans for system failures, natural disasters, terrorism and crowd control.

It should again be emphasized at this time that specific details of SOP's and EOP's, although developed, are confidential in nature as they deal with tactical operations, and as such, are not available for review unless duly authorized by the Fixed Guideway System.

9.2.7 THREAT AND VULNERABILITY IDENTIFICATION, ASSESSMENT AND RESOLUTION

An important element of the security system is the manner in which potential security threats and system vulnerabilities are identified, evaluated and resolved. Identification and data collection are crucial to the security process. Statistical and historical data are an integral part of the security process.

The Fixed Guideway System shall establish methods to collect and communicate security information so that real threats and vulnerabilities are identified. examined, and resolved. Accordingly, consideration shall be given to the following threat and vulnerability identification, assessment and resolution of security related issues.

9.2.7.1 THREAT AND VULNERABLLITY IDENTIFICATION

It is necessary to identify the major vulnerabilities and identify potential security threats. Threat and vulnerability investigations shall consider:

- security testing and inspections to include:
  - equipment preparedness
  - proficiency evaluation
  - system effectiveness exercises (security-related simulations)

- data collection
  - reports
  - security information flow

9.2.7.2 THREATANDVULNERABILITYASSESSMENT

Once threat and vulnerability data is retrieved it is important that it be analyzed to determine where the Fixed Guideway System is vulnerable and what threats are most likely to be experienced. Responsibility for assessment of these threats and vulnerabilities shall be assigned to personnel qualified in security deployment practices. Threat and vulnerability assessment shall consider:

- experienced personnel (with knowledge of the Fixed System) to be responsible for security assessment

- analysis of the Fixed Guideway System, familiarity with the communities, and knowledge of statistical methods

- dissemination of security information to interested organizations (Management, Local Police, etc.)

9.2.7.3 **THREAT AND VULNERABILITY RESOLUTION**

It is imperative that security threats and vulnerabilities be addressed to minimize crime exposure at the Fixed Guideway System. Threat and vulnerability resolution, as a minimum, includes:

- the mechanisms for activating certain types of emergency response including those authorized to respond, what levels of response are possible, and the duration the emergency response is capable of being maintained.

- the methods to be employed to investigate security breaches including the circumstances that led to the breach

- the in depth research of threats and vulnerabilities to determine if the risks(s) can be managed, and to provide criteria for long-term improvements in identified security-risk areas

- the consideration of four (4) possible alternatives associated with security problems including are:

  1. eliminate the problem through redesign, retraining or procedural changes;
  2. mitigate (minimize) the problem by increasing surveillance, changing procedures;
  3. increase the presence of security forces;
  4. accept the security risk in those instances where the incident likelihood is remote, or the impact on the system is so minor that it does not warrant action.

9.2.8 INTERNAL AND EXTERNAL AUDITS

It is important that these security, program tasks be implemented and internal reviews conducted by the Fixed Guideway System to ensure that reasonable and responsible security measures have been achieved. It is also important that periodic external reviews and audits be accomplished to evaluate the security program. These external audits may be conducted by peer groups, Local or State Police, or other regulatory agencies. The Fixed Guideway System shall conduct periodic security audits to ensure implementation of its security, program. Additionally, the NJDOT will conduct audits of the Fixed Guideway System security program at least once every three years.

9.2.9 IMPLEMENTATION RESPONSIBILITY

The Fixed Guideway System shall be responsible for implementing the security requirements specified in this section of the program plan.

10 CONFIGURATION MANAGEMENT

Describe the configuration management process that ensures that all property equipment, systems design elements, etc., are documented to configuration: accurately and completely. The process must include any changes to an individual subsystem, or a fleet/inventory wide change to be recorded on as-built drawings in a timely and effective manner. As part of the process there must be procedures for authority to make configuration changes, the process of incorporating these changes into all appropriate documentation means to ensure that all necessary units (including system safety & security) are formally made aware of changes. The process must include a section on design and procurement to track design changes, verification of as-built drawings: first article(1 st production unit) and final configuration (end product meeting specifications).

10.1 System Modification Review and Approval Process

Include in this section an overview describing how safety is assured in connection with modifications and changes to the system. The description is to include the change process as it pertains to hardware and software as well as capital and operating perspectives. As a minimum include how changes are developed, implemented, documented, and evaluated for their impact on the safety and security of system elements and the overall system. Describe the lines of authority, levels of responsibility> and internal and external organizational interfaces during the change process.

10.2 Certification Process

Describe the sign-off and certification process used for verification of operational readiness of new fixed guideway systems, major system modifications system expansions, new equipment and facilities prior to entering revenue service.

11. PROCUREMENT

Standard procurement procedures must be established that enforce and preclude the introduction of unauthorized hazardous materials and supplies, as well as defective or deficient equipment.

Internal reviews must include checks to ensure that proper procedures are being followed and materials received meet the procurement requirements.

12. INTERDEPARTMENTAL AND INTERAGENCY COORDINATION

Describe the communications process used to disseminate safety and security matters internally. and externally. These items should include passenger injuries; employee injuries; safety/fire protection inspections; accident/incident recommendation status; investigation of accidents, incidents, unsafe conditions; and performance reports. The external communication should include emergency response units, NJDOT, and other agencies as appropriate.

13. EMPLOYEE AND CONTRACTOR SAFETY PROGRAM

13.1 Transit Agency employees

This section shall include a description of the employee safety program that incorporates the applicable NEW JERSEY PUBLIC EMPLOYEES OCCUPATIONAL SAFETY AND HEALTH ACT(N.J.S.A.34:6A-25 et. seq.), SAFETY AND HEALTH STANDARDS FOR PUBLIC EMPLOYEES(N.J.A.C.12:100) and FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT requirements. These requirements include the elements of EMPLOYEE RIGHT TO KNOW; PERSONAL PROTECTION EQUIPMENT (PPE); WORK IN CONFINED SPACES; LOCKOUT AND TAGOUT; MATERIALS HANDLING, STORAGE, USE, AND DISPOSAL; HAZARDOUS MATERIALS; etc.

13.2 Contractor and Subcontractor Safety Coordination

This section shall include a description of the safety procedures and instructions to contractors. Include how the information is disseminated to contractors / subcontractors such as construction / procurement specifications, standards, meetings or other means. The procedures shall. include measures to ensure safe performance by contractors and sub-contractors during the conduct of work on the fixed guideway system. It shall also include measures to secure the work area for public and employee safety.

13.3 Hazardous Materials Program

This section shall include a description of the employee safety program that incorporates the applicable NEW JERSEY PUBLIC EMPLOYEES OCCUPATIONAL SAFETY AND HEALTH ACT (N.J.S.A.34:6A-25 et. seq.), SAFETY AND HEALTH STANDARDS FOR PUBLIC EMPLOYEES (N.J.A.C.12:100) and FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT.

14. INTERNAL AUDIT PROCESS

System Safety is the formal process of managing a safety and security program to ensure that all identified safety elements in a given environment are in place and performing as designed. The Internal Safety Audit Process is the method used to determine if all organizational elements. equipment, procedures, and functions are performing as intended from a safety and security perspective. The assets for which operational and maintenance personnel have responsibility include the safe and secure transportation of passengers, employee safety, and protection of property. Safe& and security management and good overall management are inseparable concepts. The audit process must be part of a program that includes an approved implementation plan. The plan must contain, as a minimum, the following:

14.1 Audit Responsibility

The transit agency must identify the unit or division of responsibility for oversight of the Internal Audit Process (usually the safety unit). The unit responsible for the conduct of the audit must not be the unit in charge of implementation of the items being audited.

14.2 Employee and Contractor Safety Program

Employee program verification of compliance is accomplished through the use of surveys. inspections, and analysis of injury and illness reports. For contractor programs the verification is accomplished through reviews of contract specifications, testing. and inspection of on-site work activities.

The internal audit must include the verification of employee training. certification, and retraining programs as appropriate. The review should verify that the instructions and course contents meet the expectations of the training and certification requirements. The content and presentation of the programs shall be evaluated on a periodic basis. The course shall be conducted and documented with complete and accurate records.

14.3 Audit Reporting

The audit report must be an official document which is provided to all levels of management. As part of the formal reporting, a departmental summary report is provided to the chief executive officer.

The internal audit should be conducted in a cooperative manner and include an administrative process for resolving problems or disagreements.

14.4 Audit Completeness

Audits should be done on a coordinated basis with full management support. The following audit elements, as a minimum, must be included as part of the audit procedure:

14.4.1 Cycle/Schedule - Audited departments must know when to expect audits, Audits must be scheduled to be unobtrusive. Unannounced inspections or spot audits must be approved as part of the overall audit process with concurrence of general management.

14.4.2 Checklists - A list of items to be audited must be prepared in advance. Each audited department should be given time to produce the necessary documentation. This does not preclude spot check of individual records such as maintenance records or personnel qualification records. A cooperative nature should be maintained throughout the audit process.

14.4.3 Documentation - Formal documentation of all aspects of the internal audit process must be maintained. As part of the formal documentation include all necessary reports to general management and respective departments.

14.4.4 Follow-up/Corrective action - Each audit report process must include a list of recommended corrective actions, if any. Corrective actions approved by management must be tracked for comphance.

15 DRUG AND ALCOHOL ABUSE PROGRAMS

This section must include a description of a Drug and Alcohol program that meets both the State and the Federal Department of Transportation Requirements.

Supplemental Submission
Security Element of the State Safety Oversight Program

Certification of Compliance for FTA Recipients
[certifying compliance with 49 CFR part 659.45 **(a)(3)(I** -iv)]

Date: ______________ *Submitted by Letter dated April 30, 1998*
EPL

United States Department of Transportation
Federal Transit Administration
Office of Safety and Security
400 7th Street, S.W.
Washington, D.C. 20580

I, *Theodore H. Matthews* , ***Acting** Executive Director.*
(Name) (Title)

Division of Aeronautics and Freisht Svstems submit the following information

describing the *New Jersey Department of **Transportation*** Oversight Program:
(Name of Oversight Agency)

(1) A copy of the System Safety Program Standards developed to comply with the **APTA** Manual for the Development of Rail Transit System Safety Program Plans, to include provisions for passenger security, and to establish the relationship between •

New Jersey Department of Transportation and
(Name of Oversight Agency)

New Jersey Transit • Newark City Subway System .
[Name of Rail Fixed **Guideway** Systems(s)]

(2) The procedures or process for reviewing and approving each RFGS System Safety Program Plan within *New Jersey Department of Transportation's* jurisdiction,
(Name of Oversight Agency)

including the procedures used to conduct the Three-Year Safety Review.

(3) The procedures for the investigation of accidents and unacceptable **hazardous** conditions.

(4) The procedures for ensuring that appropriate corrective actions have been taken by each RFGS to correct, eliminate, minimize, or control investigated hazardous conditions.

The attached information accurately documents the Oversight Program administered by
*New Jersey Department of **Transportation*** .
(Name of Oversight Agency)

Signed: ______________ ***Acting** Executive Director*
(Name and Title) *Division of Aeronautics and **Freight** Systems*

jlasecsub98-certif2forms

Exhibit H

ANSI 226.1, “American National Standard for Safety Glazing Material for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways”

American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Code

Standard
ANSI/SAE Z26.1-1990

Approved by American National Standards Institute
September 14, 1990
Editorial Correction August 1991

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space
INTERNATIONAL

N

American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Code

Standard
ANSI/SAE Z26.1-1990

Approved by American National Standards Institute
September 14, 1990

Report of:
Glazing Materials Standards Committee
Approved October 1989
Editorial Correction August 1991
Revision of ANSI Z26.1-1983

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American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standards. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

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Foreword

(This foreword is not part of American National Standard Z26.1- 1990.)

The American Standard Safety Code, Z26.1-1938, was developed by a sectional committee, national in scope, functioning under the procedure of the American Standards Association and under the joint sponsorship of the National Bureau of Casualty and Surety Underwriters (now the American Insurance Association) and the National Bureau of Standards. It was the first of several separate codes to be developed within the scope of Standards Committee226 on Specifications and Methods of Test for Safety Glazing Materials. That scope is as follows:

Specifications and methods of test for safety glazing material (glazing material designed to promote safety and reduce or minimize the likelihood of personal injury from flying glazing material when the glazing material is broken) as used for windshields, windows, and partitions of land and marine vehicles and aircraft.

Since the original formulation of the American National Safety Code, Z26.1-1938, the development of synthetic plastic materials has so far advanced that a number of them appear to be practical for certain uses as safety glazing materials for glazing motor vehicles operating on land highways; therefore, in the 1966 edition of this standard, but the foreword and code were modified to the extent necessary to include these synthetic plastic materials along with glass under the general term of 'safety glazing materials" reserving the use of the word "glass" as applying only to the ceramic material, and of the word "plastic" as applying only to synthetic, organic, plastic materials.

Early in its deliberations, the Z26 Committee recognized the fact that no one set of specifications or methods of test could well apply to safety glazing materials as used for all purposes. Therefore, the members decided to prepare a separate code for each of the major usages included in the scope of the main project. In keeping with that decision, this code, as its title indicates, pertains only to "Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways". Such motor vehicles and motor vehicle equipment shall include passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, slide-in campers, pick-up covers designed to carry persons while in motion, motorhomes, and trailers.

It is hoped that the test procedures and performance requirements detailed in this standard may be uniformly adopted by motor vehicle commissioners and other interested regulatory officials as the basis for their approval of the safety glazing materials in motor vehicles and motor vehicle equipment coming within their jurisdiction, or for incorporation in their regulations: that they may serve as a guide toautomobile manufacturers as to the safety glazing materials which will be acceptable to such officials; and that they may enable the consumer (the commercial operator and the general public) to have assurance that the safety glazing materials in the motor vehicle that is purchased should reduce, in comparison with glazing of ordinary types, the likelihood of injury to persons riding in such motor vehicles and motor vehicle equipment by these safety glazing materials whether they may be broken or unbroken.

It is the fundamental purpose of this standard to prescribe the functional properties of safety glazing materials in such a manner that they can be used in any place in motor vehicles and motor vehicle equipment for which they possess those mechanical or optical properties, or both, that are requisite and appropriate. For example, safety glazing materials for windshields must pass a specified group oftestrequirements, all of which currently can be met only by certain laminated safety glazing: however, if and when other safety glazing materials are developed which possess properties such that they, too. fulfill the requirements of the prescribed tests for this location, they may also be used; and similar reasoning would apply for other locations. This standard is designed to serve two purposes: (1) to afford a basis for standards for adoption in regulations by governmental regulatory bodies; or (2) for use by motor vehicle commissioners or others as reference standards in such cases as they may have discretionary authority to adopt these or other standards in connection with the approval of safety glazing materials or other items of use in or on motor vehicles and motor vehicle equipment.

This standard does not state that safety glazing materials shall be used or to what extent they shall be used in glazing motor vehicles and motor vehicle equipment. Such requirements rest with either the legislative or administrative authority. When by law or regulation escape or emergency egress openings are required and when such requirement is met by use of glazed openings, Test 25 (see 5.25) is provided as a means of measuring and establishing the escape value of the safety glazing material.

This standard, which is the result of extended and careful consideration of available knowledge and experience on the subject, is intended to provide minimum requirements that are recommended for use, adoption, and enforcement by federal, state, and local administrative authorities.

Caution should be exercised not to make laws and regulations dealing with this subject so inflexible as to preclude subsequent adoption of technological advancements in the development of safety glazing materials.

Except for special requirements for specified locations, safety glazing materials of seven general types can meet some or all requirements detailed in this standard. All **seven** types are commercially available today. Each of them possesses its own distinct& safety characteristics. The seven types may be briefly described as follows:

(1) **Laminated Glass.** This consists of two or more pieces of she-et, plate, or float glass bonded together by an intervening layer or layers of plastic material. It will crack or break under sufficient impact, but the pieces of glass tend to adhere to the plastic. If a hole is produced, the edges are likely to be less jagged than would be the case with ordinary annealed glass.

(2) **Glass-Plastic Glazing Material.** This means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

(3) **Tempered Glass.** (Other terms such as "heat treated glass," "case hardened glass," and "chemically tempered glass" are used also.) This consists of a single piece of specially treated sheet, plate, or float glass possessing mechanical strength substantially higher than annealed glass. When broken at any point, the entire piece breaks into small pieces that have relatively dull edges as compared to those of broken pieces of ordinary annealed glass.

(4) **Wired Glass.** This consists of a single piece of glass with a layer of meshed wire completely imbedded in the glass but not necessarily in the center of the glass.

(5) **Plastic.** A plastic is a material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

(6) **Multiple Glazed Unit.** This consists of two or more sheets of glazing material separated by an airspace or spaces and glazed in a common mounting. For the purposes of this standard, multiple glazed units are divided into two classes:

(a) Class 1 comprises multiple glazed units in which each component single layer or laminated layer complies with the appropriate requirements of this standard.

(b) Class 2 comprises multiple glazed units in which any component single layer or laminated layer does not comply with the appropriate requirements of this standard.

(7) **Bullet-Resisting Glazing.** This consists of one or more layers of glass bonded together with one or more layers of transparent plastic or of transparent plastic material, solid or laminated, that can meet the bullet-resisting requirements of this standard and bullet resistant shields or barriers that are installed completely inside a motor vehicle behind and separate from glazing materials that comply with the requirements of this standard.

The Z26 Committee and the Secretariat believe that this standard reflects the best current technology in the art of automotive glazing. It is recognized that new developments are to be expected in safety glazing materials, and that revisions of the standard will be necessary as the art progresses and as further experience is gained. It is felt, however, that uniform requirements are very much needed, that the standard in its present form permits the use of the more desirable types of safety glazing materials now commercially available, and that it distinguishes between the better and the poorer grades of those types, as well as prescribing and, in some cases, limiting the places at which certain types may be used.

For clarity, the following definitions are provided:

(1) **Camper.** Means a structure designed to be mounted in the cargo area of a truck. or attached to an incomplete vehicle with motive power, for the purpose of providing shelter for persons.

(2) **Motorhome.** Means a multipurpose passenger vehicle that provides living accommodations for persons.

(3) Pick-Up Cover. Means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

(4) Slide-In Camper. Means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

(5) Trailer. Means a motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.

(6) Multipurpose Passenger Vehicle. Means a motor vehicle with motive power, except a trailer, designed to carry ten persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.

(7) Passenger Car. Means a motor vehicle with motive power, except a multipurpose passenger vehicle, motorcycle or trailer, designed for carrying ten persons or less.

Footnotes to this standard are included for purposes of clarification and are not part of American National Standard 226.1-1990.

Suggestions for improvement of this standard will be welcome. They should be sent to the Secretariat at the Society of Automotive Engineers, Inc., 3001 West Big Beaver Road, Suite 320, Troy, Michigan 48084.

This standard was processed and approved for submittal to ANSI by the Society of Automotive Engineers/American National Standards Committee on Specifications and Methods of Test for Safety Glazing Material, 226. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the 226 Committee had the following members:

R. L. Morrison, Chairman
J. Krueger, Secretary

NAME OF REPRESENTATIVE	ORGANIZATION REPRESENTED
B. Anson	Rohm and Haas Company
J. Banks	PPG Industries
J. Beck	Ford Motor Company
L. Bitter	Donnelly Corporation
K. Dean	General Motors Corporation
E. Edge	Individual Member
R. Fiedor	Individual Member
H. Gorry	Guardian Industries
C. Harper	U.S. Department of Transportation National Highway Traffic Safety Administration
S. Herliczek	Libbey-Owens-Ford Company
D. Houston	Individual Member
D. Jacques	Transport Canada
J. Kochanowski	General Electric Company
R. LaBrecque	Chrysler Corporation
R. Lovett	Individual Member
L. Masonick	Individual Member
P. Mattimoe	Individual Member
S. McCready	Cyro
J. Miller	Sherwin Williams Company
G. Mont	Monsanto Company
R. Morrison	Glass Tempering Association
N. Nitschke	Glasstech
T. Raabis	Mercedes Benz

NAME OF REPRESENTATIVE	ORGANIZATION REPRESENTED
C. Rapezzi	Individual Member
C. Robb	ETL Testing Laboratories, Inc.
D. Schindler	DuPont
J. Smith	Canadian Standards Association
R. Streeper	3M Company
J. Turnbull	Individual Member

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1. Definitions

1.1 Safety Glazing Materials.

A product consisting of organic and/or inorganic materials so constructed or treated to reduce, in comparison with annealed sheet, plate or float glass, the likelihood of injury to persons as a result of contact with these safety glazing materials when used in a vehicle, whether they may be broken or unbroken, and for which special requirements regarding visibility, strength and abrasion are set-forth.

1.2 Safety Glass.

The term "safety glass" means safety glazing materials predominantly ceramic in character that meet the appropriate requirements of this code, including (but not limited to) laminated glass, tempered glass, and wire glass.

1.3 Safety Glazing Plastics.

The term "safety glazing plastics" includes any safety glazing material, predominantly synthetic organic in character, that meets the appropriate requirements of this code, including single-ply and laminated products whether rigid or flexible.

1.4 Glass-Plastic Glazing Material.

Means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

1.5 Multiple Glazed Unit.

The term "multiple glazed unit" means two or more sheets of safety glazing material separated by an airspace or spaces and glazed in a common mounting. For the purposes of this standard, multiple glazed units are divided into two classes:

(1) Class 1 comprises multiple glazed units in which each component single layer or laminated layer complies with the appropriate requirements of this code.

(2) Class 2 comprises multiple glazed units in which any component single layer or laminated layer does not comply with the appropriate requirements of this code.

1.6 Bullet-Resisting Glazing.

The term "bullet-resisting glazing" means a glazing material comprised of one or more layers of glass bonded together with one or more layers of transparent plastic or transparent plastic material, solid or laminated, that can meet the requirements for bullet resistance of this code (Test 27, Ballistics).

Bullet-resisting glazing for motor vehicles operating on land highways is available in four types:

(1) Type MP glazing, ballistically resistant to medium-power small arms ammunition; super 38 automatic revolver; muzzle velocity 1280 f/s (380 m/s).

(2) Type HP glazing, ballistically resistant to high-power small arms ammunition; .357 Magnum revolver, muzzle velocity 1450 f/s (442m/s).

(3) Type SP glazing, ballistically resistant to super-power small arms ammunition; .44 Magnum revolver; muzzle velocity 1470 f/s (448 m/s).

(4) Type RR glazing, ballistically resistant to high-power rifle ammunition; 30-06 military rifle: muzzle velocity 2410 f/s (735 m/s). Laminates or homogeneous glazing materials that meet the appropriate requirements of this standard in the location as specified may be used as bullet-resisting glazing for the foregoing types provided that they satisfactorily meet the requirements of 1.1 through 3.2 and 12.1 through 12.4 of ANSI/UL 752-1980, Safety Standard for Bullet-Resisting Equipment.

1.7 Bullet Resistant Shield.

Means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

1.8 Readily Removable Windows.

The term "readily removable windows" as used in this standard means windows that can be quickly and completely removed from the motor vehicle without tools. Readily removable windows in buses having a GVWR of more than 10,000 lbs (4540Kg), which shall include push-out windows and windows mounted in emergency exits that can be manually pushed out of their location in the vehicle without the use of tools, regardless of whether such windows remain hinged at one edge.

2. General

2.1 Use of Descriptive Terms.

As the definition indicates, safety glazing materials, in comparison with ordinary sheet glass, plate glass, or float glass, are intended to reduce the likelihood of injury or the severity of injury in the event of their breakage. Therefore, terms such as "nonbreakable," "nonscatterable," and "nonsplinterable" should not be interpreted by the driving public as meaning that absolute protection is afforded to the occupants of the vehicle by the safety glazing materials so described, as the descriptive terms might seem to warrant. No such terms are used in this standard.

Bullet-resisting glazing should not be termed "bullet-proof," since no bullet-resisting glazing is completely resistant to penetration by all types of missiles fired from all types of armament.

2.2 Degree of Safety.

One safety glazing material may be superior for protection against one type of hazard, whereas another may be superior against another type. Since accident conditions are not standardized, no one type of safety glazing material can be shown to possess the maximum degree of safety under all conditions, against all conceivable hazards.

23 Purpose of Tests.

The tests described in this standard are for the purpose of determining whether a safety glazing material has certain desirable and obtainable qualities for its acceptance under this code. Many of the tests are of such severity that even a satisfactory product will show occasional failures to an extent limited by the requirements of the test.

2.4 Referenced Standards.

This standard is intended for use in conjunction with the following standards:

ANSI/UL 752-1980, Safety Standard for Bullet Resisting Equipment’

ASTM D 618-61 (1981). Methods of Conditioning Plastics and Electrical Insulating Materials for Testing[2]

ASTM D 1003-61 (1977), Method of Test for Haze and Luminous Transmittance of Transparent Plastics*

ASTM D 1044-82, Method of Test for Resistance of Transparent Plastics to Surface Abrasion[2]

ASTM D 149964 (1977), Recommended Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics*

ASTM D 2440-8 1, Standard Method of Test for Durometer Hardness of Rubber Property’

ASTM G 23-81, Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials’

IS0 3536/1 Road vehicles - Safety Glazing Materials - Vocabulary - Part 1

IS0 3537 Road vehicles - Safety Glazing Materials - Test Methods for Mechanical Properties

IS0 3538 Road vehicles - Safety Glazing Materials - Test Methods for Optical Properties

IS0 3917 Road vehicles - Safety Glazing Materials - Test Methods for Resistance to Radiation, High Temperature, Humidity and Fire

SAE Recommended Practice J673, November 1983, Automotive Safety Glazing

SAE Recommended Practice J 938a, June 1976, Drop Test for Evaluating Safety Glass for Use in Automobile Windshields[3]

‘Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
*Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.
‘Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

3. Specimens to Be Tested

3.1 General

3.1.1 Variation in Required Specimens. The specimens required vary according to the different groups of tests that must be met by safety glazing materials. Sufficient specimens to meet these various tests shall be furnished, as described in 3.2 to 3.8.

3.12 Requirements for All Specimens. All specimens of safety glazing materials shall be furnished representative of the model number (see footnote 27 p. 39) with the edges finished, holes drilled where necessary, and masked, if desired, in accordance with the commercial practice of the manufacturer.

3.2 Laminated Glass, Glass-Plastic Glazing Material: Tempered Glass, Wired Glass.

The samples described in 3.2.1 through 3.2.4 shall bc submitted.

3.2.1 In the case of tempered and wired glass:

(1) Twenty 12- x 12-in (305- x 305-mm), substantially flat specimens or, optionally, seventeen 12- x 12-in (305- x 305-mm) and three 3- x 12-in (76- x 305-mm), substantially flat specimens shall be furnished.

(2) Three 4- x 4-in (102- x 102-mm), flat specimens having both surfaces substantially plane and parallel, with a 1/4-in (6.35-mm) diameter holecentrally drilled therethrough, shall be furnished. Where fixturing for mounting specimens on a Taber Abraser is available, the l/4-in (6.35-mm) hole is not necessary.

(3) In addition, for Fracture, Test 7, six production parts representing each model construction are to be furnished for the test.

3.2.2 In the case of laminated glass for windshield use:

(1) Thirty-six 12-x 12-in (305-x 305-mm), substantially flat specimens or, optionally, thirty-three 12- x 12-in (305- x 305-mm) and three 3- x 12-in (76- x 305-mm), substantially flat specimens shall be furnished.

(2) Three 4- x 4-in (102- x 102-mm), flat specimens having both surfaces substantially plane and parallel, with a 1/4-in (6.35-mm) diameter hole centrally drilled therethrough, shall be furnished. Where fixturing for mounting specimens on a Taber Abraser is available, the l/4-in (6.35-mm) hole is not necessary.

3.2.3 In the case of glass-plastic glazing materials for windshield use:

(1) Thirty-nine 12- x 12-in (305- x 305-mm), substantially flat specimens.

(2) Eight 4- x 4-in (102- x 102-mm), flat specimens having both surfaces substantially plane and parallel.

(3) Four 2- x 6-in (51- x 152-mm), substantially flat specimens.

(4) Fifteen I- x 7-in (25- x 178-mm), substantially flat specimens.

(5) Four 1/2- x 6-in (13- x 152-mm), flat specimens.

3.2.4 In the case of laminated glass for glazing applications other than windshields:

(1) Twenty-six 12- x 12-in (305- x 305-mm), substantially flat specimens, or, optionally, twenty-three 12- x 12-in (305- x 305-mm) and three 3- x 12-in (76- x 305-mm), substantially flat specimens shall be furnished.

(2) Three 4- x 4-in (102- x 102-mm), flat specimens having both surfaces substantially planc and parallel, with a 1/4-in (6.35-mm) diameter hole centrally drilled therethrough, shall be furnished. Where fixturing for mounting specimens on a Taber Abraser is availablc, the 1/4-in (6.35-mm) hole is not necessary.

3.3 Curved Laminated Glass and Glass-Plastic Glazing Material for Windshields

3.3.1 Curved Laminated Glass for Windshields. Where curved laminated safety glass is proposed for use in windshields. three additional specimens shall be submitted. These specimens shall be approximately 12- x 12-in (305- x 305-mm) in size and shall be cut from the windshield at the section of greatest curvature (minimum radius).

3.3.2 Curved Glass-Plastic Glazing Material for Windshields. Where curved glass-plastic glazing material is proposed for use in windshields, four additional specimens shall be submitted. These specimens shall be approximately 12- x 12-in (305- x 305-mm) in size and shall be cut from the windshield at the section of greatest curvature (minimum radius).

[4]The inward facing surface of each glass-plastic laminated glazing specimen shall be identified.

3.4 Multiple Glazed Units.

In the case of multiple glazed units, which for the purposes of this standard are divided into two classes, the specimens described in 3.4.1 and 3.4.2 shall be furnished as unitary structures in accordance with the commercial practice of the manufacturer.

3.4.1 Class 1. If each of the individual components of the multiple glazed unit comply with this code, the specimens described in 3.4.1.1 and 3.4.2.2 are required.

3A.l.l For windshield use:

(1) Ten 12- x 12-in (305- x 305-mm), substantially flat specimens, or, optionally, seven 12- x 12-h (305- x 305-mm) and 3- x 12-k (76- x 305-mm), substantially flat specimens shall be furnished.

(2) Where curved multiple glazed units are proposed for use in windshields, three additional specimens shall be furnished. These specimens shall be complete windshields with an area approximately 12- x 12-in (305- x 305-mm) outlined at the section of greatest curvature (minimum radius).

3.4.1.2 For glazing applications other than windshields, three 12- x 12-in (305- x 305-mm), substantially fiat specimens, or, optionally, three 3- x 12-h (76- x 305-mm), substantially flat specimens shall be furnished.

3.4.2 Class 2. If any of the individual components of the multiple glazed unit do not comply with this code, the specimens described in 3.4.2. I through 3.4.2.3 are required.

3.4.2.1 For windshield use:

(1) Thirty-three 12- x 12-in (305- x 305-mm), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 12- x 12-in (305- x 305-mm), substantially flat specimens are required.

(2) Three 4- x4-h (102- x 102-mm), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 114-h (6.35-mm) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 114-h (6.35-mm) hole is not necessary.

(3) Where curved multiple glazed units are proposed for use in windshields, three additional specimens shall be furnished. These specimens shall be complete windshields with an area approximately 12- x 12-in (305-x 305-mm) outlined at the section of greatest curvature (minimum radius).

3.4.2.2 For glazing applications other than windshields in the first group under Class 2:

(1) Twenty-three 12- x 12-in (305- x 305-mm), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 12- x 12-h (305- x 305-mm), substantially flat specimens are required.

(2) Three 4- x 4-in (102- x 102-mm), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 1/4-in (6.35-mm) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 1/4-in (6.35-mm) hole is not necessary.

3.4.2.3 For glazing applications other than windshields in the second group under Class 2:

(1) Thirty-five 12- x 12-in (305- x 305-mm), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 12-x 12-in (305- x 305-mm), substantially flat specimens are required.

(2) Three 4- x 4-in (102- x 102-mm), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 1/4-in (6.35-mm) diameter hole centrally drilled therethrough. Where fixturing fur mounting specimens on a Taber Abraser is available, the 1/4-in (6.35-mm) hole is not necessary.

3.5 Plastics More Than 0.050 in (1.27 mm) in Thickness.

For plastics more than 0.050-in (I .27 mm) in thickness, the following specimens are required:

(1) Seventeen 12- x 12-in (305- x 305-mm), substantially flat specimens.

(2) Three 4- x 4-h (102- x 102-mm), flat specimens having both surfaces substantially plane and parallel, with a 1/4-in (6.35-mm) diameter hole centrally drilled therethrough.

(3) Twenty I- x 7-in (25- x 178-mm), substantially flat specimens.

Item 6. Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles,Slide-In Campers, Pick-Up Covers Designed to Carry Persons While in Motion, Motorhomes, in the Rear Windows of Convertible Passenger Car Tops, in Windscreens for Motorcycles, in Flexible Curtains or Readily Removable Windows, or in Ventilators Used in Conjunction with Readily Removable Windows. Safety glazing materials that comply with Tests 2, 16, 19, 20, 22, and either 23 or 24 may be used in a motor vehicle only in the following specific locations:

(a) Trailers.

(b) The rear windows of convertible passenger car tops.

(c) Windscreens for motorcycles.

(d) Flexiblecurtainsorreadily removable windowsor in ventilators used in conjunction with readily removable windows.

(e) Windows and doors in motorhomes, except for the windshield, forward-facing windows, and windows to the immediate right of left of the driver.

(f) Windows, except forward-facing windows, and doors in slide-in campers and pick-up covers.

Item 7. Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles, Slide-In Campers, Pick-Up Covers Designed to Carry Persons While in Motion, Motorhomes, and at Levels Not Requisite for Driving Visibility in the Rear Window of Convertible Passenger Car Tops, in Windscreens for Motorcycles, in Flexible Curtains or Readily Removable Windows, or in Ventilators Used in Conjunction with Readily Removable Windows. Safety glazing materials that comply with Tests 16, 19, 20, 22, and either23 or 24 may be used in a motor vehicle only in house- or property-carrying trailers and at levels not requisite for driving visibility in the following specific locations:

(a) The rear windows of convertible passenger car tops.

(b) Windscreens for motorcycles.

(c) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(d) Windows and doors in motorhomes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.

(e) Windows,exceptforwa.rd-facing windows, and doors in slide-in campers and pick-up covers.

(f) Standee windows in buses.

(g) Interior partitions.

(h) Openings in the roof.

Item 8. Safety Glazing Materials for Use Only in Folding Doors, Standee Windowsin Buses, Trailers, Multipurpose Passenger Vehicles, Slide-In Campers, Pick-Up Covers Designed to Carry Persons While in Motion, Motorhomes, Rear of Driver in Truck or Truck Tractors, and Rearmost Windows in Buses. Safety glazing materials that comply with Tests 1, 2, 3, 4, 11. and 18, or multiple glazed units that comply with Tests 1, 2, 3, 5, 11, 14, and 18 may be used in a motor vehicle only in the following specific locations:

(a) Folding doors.

(b) Standee windows in buses.

(c) Trailers.

(d) Rear of driver in trucks and truck tractors.

(e) Rearmost windows in buses.

(f) Windows and doors in motorhomes, except for the windshield and windows to the immediate right or left of the driver.

(g) Windows and doors in slide-in campers and pick-up covers.

Item 9. Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles,Slide-in Campers, Pick-Up Covers Designed to Carry Persons While in Motion, Motorhomes, Standee Windows in Buses, and at Levels Not Requisite for Driving Visibility in Folding Doors, Rear of Driver in Trucks or Truck Tractors, and Rearmost Windows in Buses. Safety glazing materials that comply with Tests 1, 3, 4, and 11, or multiple glazed units that comply with Tests 1, 3, 5, 11, and 14, may be used in a motor vehicle only in trailers, standee windows in buses, and at levels not requisite for driving visibility in the following specific locations:

(a) Folding doors.

(b) Rear of driver in trucks and truck tractors.

(c) Rearmost windows in buses.

(d) Windows and doors in motorhomes, except for the windshield, and windows to the immediate right or left of the driver.

(e) Windows, and doors in slide-in campers and pick-up covers.

Item 10. Safety Glazing Material for Use Where Bullet Resistance is Required Anywhere in Motor Vehicle. Bullet-resisting glazings that comply with Tests 18[7], 27, 28, 29, 30, 31, and 32 may be used anywhere in a motor vehicle.

Item 11A. Safety Glazing Material for Use Where Bullet Resistance Is Required in Motor Vehicles Except Windshields. Bullet-resisting glazings that comply with Tests 18,[7] 27, 28, 29, 30, and 31 may be used anywhere in a motor vehicle except windshields.

Item 11B. Safety Glazing Material for Use Where Bullet Resistance Is Required in Motor Vehicle Except Windshields and Glazing of Windows to the Immediate Right or Left of the Driver and in Rearmost Window if the Latter Is Used for Driving Visibility. Bullet-resisting glazings that comply with Test 19,[7] 20,[7] 21,[8] 24,[8] 27, 28,[9] and 29,[9] may be used anywhere in a motor vehicle except windshields, glazing of windows to the immediate right or left of the driver, and in rearmost window if the latter is used for driving visibility.

Item **11C. Safety Glazing Material for Use** in Bullet **Resistant Shields.** Bullet resistant glazing that complies with Tests 2, 17, 19, 20, 21, 24, 27, 28, 29, 30, and 32 and the labeling requirements of Section 7 may be used only in bullet resistant shields that can be removed from the motor vehicle easily for cleaning and maintenance. A bullet resistant shield may be used in areas requisite for driving visibility only if the combined parallel luminous transmittance with perpendicular incidence through both the shield and the permanent vehicle glazing is at least 60 percent

Item **12. Rigid Plastics. Safety** plastic materials that comply with Tests 10, 13, 16, 19, 20, 21, and 24 with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of Section 7, may be used in a motor vehicle only in the following specified locations at levels notrequisite for driving visibility.

(a) Windows and doors in slide-in campers and pick-up covers.

(b) Motorcycle windscreens below the intersection of a horizontal plane 15-in vertically above the lowest seating position.

(c) Standee windows in buses.

(d) Interior partitions.

(e) Openings in the roof.

(f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(g) Windows and doors in motorhomes, except for the windshield and windows to the immediate right or left of the driver.

(h) Windows and doors in buses except for the windshield and windows to the right and left of the driver.

Item 13. Flexible Plastics. Safety plastic materials that comply with Tests 16, 19, 20, 22, and 23, or 24, with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of Section 7, may be used in the following specific locations at levels not requisite for driving visibility.

(a) Windows, except forward-facing windows, and doors in slide-in campers and pick-up covers.

(b) Motorcycle windscreens below the intersection of a horizontal plane 15-in vertically above the lowest seating position.

(c) Standee windows in buses.

(d) Interior partitions.

[7] Flat, certified representative specimens of 1/4-in (6.35-mm) thickness are to be used.
[8] Except for monolithic configurations, where specimens of 1/4-in (6.35-mm) thickness are to be used, the specimen thickness is to correspond to that used in Test 27.
[9] Test not required for monolithic configurations.

(e) Openings in the roof.

(f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(g) Windows and doors in motorhomes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.

Item 14. Safety Glazing Material for Use Anywhere in a Motor Vehicle Except That It May Not be Used in Convertibles, in Vehicles That Have No Roof or in Vehicles Whose Roofs are Completely Removable. Safety glazing materials that comply with Tests 1, 2, 3, 4, 9, 12, 15, 16, 17, 18, 19, 24, 26, and 28, may be used anywhere in a motor vehicle except that it may not be used in convertibles, in vehicles that have no roof or in vehicles whose roofs are completely removable.

5. Test Specifications.

In many of the following test specifications it is indicated in the test that specific safety glazing materials are under consideration. At the time of writing, these specific safety glazing materials are the only ones known to fulfill the requirements of the specific test. It is intended that if and when other safety glazing materials are developed which possess properties such that they, too, fulfill the requirements of each of the specific tests listed in one or another of the groups of tests for the several items of Table 1, they may be used interchangeably with any other safety glazing materials meeting the requirements of the same group of tests.

The conditions of the test are, in each instance, designed to show whether the safety glazing material under test conditions approaches the most satisfactory combination of desirable properties. To this end, some tests are written so that occasional failure is allowed. Such tests are better adapted to indicate a satisfactory product than less severe tests allowing no failures.

Unless otherwise specified, interpretation of results should bc made at the time the test is performed. This is necessary because in the case of some of these tests the condition of the sample is subject to further change over a period of time.

Multiple glazed units shall be tested on both sides using separate specimens for each side in Test 14.

5.1 Light Stability, Test 1.

51.1 Purpose of Test. The purpose of this test is to determine the regular (parallel) luminous transmittance of the safety glass or multiple glazed unit before and after irradiation, thereby indicating the suitability of the safety glazing material and whether or not it is adversely affected by exposure to simulated sunlight over an extended period of time.

51.2 Procedure

5.1.2.1 Three 12- x 12-in (305- x 305-mm) or three 3- x 12-in (76- x 305-mm), flat specimens as submitted shall be tested forregular (parallel) luminous transmittance at normal incidence calculated to International Commission on Illumination "Illuminant A."[10]

5.1.2.2 After the regular (parallel) luminous transmittance has been determined, the same three specimens shall be placed 9-in (229-mm) from a source of ultraviolet radiation." A portion of each specimen shall be protected from the radiation. The lamp shall beoperated with 170 volts across the tube and with a current of 4 amperes. The temperature of the specimens shall be maintained within thelimitsof 100°F and 120°F (38°C and 49°C) throughout the test. The face of each specimen that would be glazed to the outside of the motor vehicle shall be toward the lamp. The time exposure shall be 100 hours.

Alternate procedure. After the regular (parallel) luminous transmittance has been determined, the same three specimens shall be placed 9-in (229-mm) from a source of ultraviolet radiation." A portion of each specimen shall be protected from the radiation. The lamp shall be operated with 115 to 130 volts across the primary winding of its power supply transformer.[13] The temperature of the specimens shall be maintained within the limits of 100°F and 120°F (38°C and 49°C) throughout the test. The face of each specimen that would be glazed to the outside of the motor vehicle shall be toward the lamp. The time exposure shall be 100 hours.[14]

One type of suitable light stability test cabinet and its associated electrical equipment are shown in Fig. Al of the Appendix (see insert, cover 3).

5.1.2.3 The irradiated specimens shall again be tested for regular (parallel) luminous transmittance at normal incidence calculated to International Commission on Illumination "Illuminant A."

51.3 Interpretation of Results. The irradiated specimensshall retain at least 70% of the original transmittance as determined on the specimens as submitted. A very slight discoloration, noticeable only when specimens are placed on a white background, may develop, but defects other than this discoloration shall not develop.

5.1.4 Additional Procedure. (This additional procedure is not applicable to multiple glazed units or tempered glass.) After the transmission measurements have been made, the same three irradiated specimens shall be immersed, vertically on edge, in

"International Commission on Illumination "Illuminant A" consists of a tungsten lamp operated at a temperature of 2581°C. Suitable lamps properly aged and calibrated are obtainable from the ETL Testing Laboratories, Inc., Industrial Park, Cortland, NY 13045.

"Such as Uviarc test cabinet, 220-volt Cooper Hewitt laboratory outfit, or the equivalent.

[12] Such as General Electric H12T3 mercury lamp or the equivalent.

[13] Such as General Electric 9T65Y80G4 or the equivalent.

'"General Electric quartz mercury vapor arc lamp H12T3/1 is a suitable substitute for H12T3, as are GTE-Sylvania lamps H750T/12B and H750T3/126. Suitable alternate power supply transformers arc the General Electric 9T68Y311G4 ballast (which includes a capacitor) for 115- to 130-volt primary supply and the W2083 ballast for 220- to 240-volt primary supply, available from Shape Magnenonics, 901 North DuPage Avenue, Lambard, IL 60148.

Table 1
Grouping of Tests

	Item 1			Item 2					Item 3					Item 4
	Safety Glazing Material for use Anywhere in Motor Vehicle.			Safety Glazing Material for use Anywhere in Motor Vehicle Except Windshields.					Safety Glazing Material for use Anywhere in Motor Vehicle Except Windshield and Certain Specified Locations					Safety Glazing Material for use in Motor Vehicle only in Specific Locations.
		Multiple Glazed Unit				Multiple Glazed Unit					Multiple Glazed Unit			
							Class 2					Class 2		
Test Number	Laminated Glass	Class 1	Class 2	Laminated Glass	Tempered Glass	Class 1	Any Group		Laminated Glass	Tempered Glass	Class 1	Any Group		Rigid Plastics
1 Light stability	1	1	1	1	1	1	1	1	1		1	1	1	
2 Luminous transmittance	2	2	2	2	2	2	2	2						2
3 Humidity test	3		3	3			3	3	3			3	3	
4 Boil test	4			4					4					
5 Bake test			5				5	5				5	5	
6 Impact, ball, 10ft. (3.05 m)					6			6		6			6	
7 Fracture test					7			7		7			7	
8 Impact, shot bag, 8ft. (2.44 m)					8			8		8			8	
9 Impact, dart, 30ft. (9.14 m)	9		9	9			9		9			9		
10 Impact, dart														10
11 Impact, dart, 10ft. (3.05 m)														
12 Impact, ball, 30ft. (9.14 m)	12		12	12			12		12			12		
13 Impact, ball														13
14 Impact, ball			14				14	14				14	14	
15 Deviation and distortion	15	15	15											
16 Weathering test														16
17 Abrasion resistance														17
18 Abrasion resistance	18		18	18	18		18	18						
19 Chemical resistance														19
20 Chemical resistance														20
21 Dimensional stability														21
22 Flexibility test														
23 Flammability test														
24 Flammability test														24
25 Egress test														
26 Penetration resistance	26		26											
27 Ballistics test														
28 Temperature change														
29 Impact, ball, 20ft. (6.1 m)														
30 Light stability														
31 Luminous transmittance														
32 Deviation and distortion														

Note: For convenience, each column on this table (as well as the text of the tests that follow) designates the specific type of material that will meet the enumerated tests if it is of satisfactory quality. If and when other materials are developed that possess properties so that they also meet one or another of the prescribed groups of tests, they may be used interchangeably with the corresponding materials specified in this table.

Table 1 (Cont)
Grouping of Tests

Item 5	Item 6	Item 7	Item 8	Item 8	Item 9	Item 9	Item 10	Item 11A	Item 11B	Item 11C	Item 12	Item 13	Item 14
Safety Glazing Material for use in Motor Vehicle only in Specific Locations at Levels Not Requisite for Driving Visibility	Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles, Slide-in Campers, Pick-up Covers Designed to Carry Persons While in Motion, Motorhomes, Rear Windows of Convertible Passenger Car Tops, Windscreens for Motorcycles, Flexible Curtains or Readily Removable Windows, or in Ventilators used in Conjunction with Readily Removable Windows.	Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles, Slide-In Campers, Pick-up Covers Designed to Carry Persons While in Motion, Motorhomes, and at levels not Requisite for Driving Visibility in the Rear Windows of Convertible Passenger Car Tops, Windscreens for Motorcycles, Flexible Curtains or Readily Removable Windows, or in Ventilators used in Conjunction with Readily Removable Windows.	Safety Glazing Material for Use Only in Folding Doors, Standee Windows in Buses, Trailers, Multipurpose Passenger Vehicles, Slide-in Campers, Pick-Up Covers Designed to Carry Persons while in motion, Motorhomes, Rear of Driver in Truck or Truck Tractors, and Rearmost Windows in Buses.		Safety Glazing Material for Use Only in Trailers, Multipurpose Passenger Vehicles, Slide-In Campers, Pick-up Covers Designed to Carry Persons While in Motion, Motorhomes, Standee Windows in Buses, and at levels not Requisite for Driving Visibility in Folding Doors, Rear of Driver in Trucks or Truck Tractors, and Rearmost Windows in Buses.		Safety Glazing Material for use where Bullet Resistance is Required Anywhere in Motor Vehicle.	Safety Glazing Material for use where Bullet Resistance is Required Anywhere in Motor Vehicle Except Wind-shields.	Safety Glazing Material for Use Where Bullet Resis-tance is Required in Motor Vehicle Except Wind-shields and Glazing of Windows to Immedi-ate Right or Left of Driver and in Rearmost Window if Latter is for Driving Visibility.	Safety Glazing Material for use in Bullet Resis-tant Shields	Safety Glazing Material for Use Only As Doors and Windows in Slide-In Campers and Pick-Up Covers, Motorcycle Windscreens Below the Intersection of a Horizontal Plane 15 inches Vertically Above the Lowest Seating Position, Standee Windows in Buses, Interior Partitions, Roof Openings, Flexible Curtains or Readily Removable Windows or Ventilators Used in Conjunction with Removable Windows, Windows and Doors in Motor Homes and Buses Except Windshield and Body Glazing Directly to Right and Left of Driver.	Safety Glazing Material for Use Only in Slide-In Camper and Pick-up Cover Windows (Not Forward-Facing or Doors), Motorcycle Windscreens Below the Intersection of a Horizontal Plane 15 inches Vertically Above the Lowest Seating Position, Standee Windows in Buses, Interior Partitions, Openings In the Roof, Flexible Curtains or Readily Removable Windows or In Ventilators Used in Conjunction with Readily Removable Windows, or In Ventilators Used In Conjunction with Readily Removable Windows, Windows and Doors in Motor Homes, Except for Use in Windshields, Forward-Facing Windows and the Windows to the immediate Right or Left of the Driver.	Safety Glazing Material for Use Anywhere in a Motor Vehicle.
				Multiple Glazed Unit		Multiple Glazed Unit							
Rigid Plastics	Flexible Plastics	Flexible Plastics	Wired Glass	Class 2	Wired Glass	Class 2		Laminated Glass	Plastics	Plastics	Rigid Plastics	Flexible Plastics	Glass Plastics
			1	1	1								
	2		2	2						2			2
			3	3	3	3							3
			4		4								4
				5		5							
													9 on exterior surface
10											10		
			11	11	11	11							
													12
13											13		
				14		14							
													15
16	16	16									16	16	16 on exterior surface
										17			17 on interior surface
			18	18			18*	18*					18 on exterior surface
19	19	19							19*	19	19	19	19 on interior surface
20	20	20							20*	20	20	20	
21									21†	21	21		
	22	22										22	
24	23 or 24	23 or 24							24†	24	24		24 on interior surface
													26 on interior surface
							27	27	27	27			
							28	28	28‡	28			28
							29	29	29‡	29			
							30	30		30			
							31	31					
							32			32			

*Flat, certified representative specimens of 1/4-in (6.35-mm) thickness shall be used.
†Except for monolithic configurations, where specimens of 1/4-in (6.35-mm) thickness shall be used, specimen thickness shall correspond to that used in Test 27.
‡Test not required for monolithic configurations.

water at 150°F (66°C) for 3 minutes and then quickly transferred to and similarly immersed in boiling water. The specimens shall be kept in the boiling water for 10 minutes and then removed. The first immersion is intended to reduce the possibility of thermal shock breakage and is optional.

5.1.5 Interpretation of Results of Additional Procedure. No bubbles or other noticeable decomposition shall develop in the irradiated portion.

5.2 Luminous Transmittance, Test 2.

5.2.1 Purpose of Test. The purpose of this test is to determine the regular (parallel) luminous transmittance of safety glazing material intended for use at levels in motor vehicles requisite for driving vision.

5.2.2 Procedure. If safety glass is being tested, the data obtained from Test 1 through 5.1.3 shall be used. If plastic is being tested, the data obtained in Test 16 shall be used. No additional samples other than those tested in Test 1 or 16 are required in this test.

5.2.3 Interpretation of Results. Safety glazing materials or multiple glazed assemblies thereof intended for use at levels requisite for driving visibility in the motor vehicle shall show regular (parallel) luminous transmittance of not less than 70% of the light, at normal incidence, both before and after irradiation.[15] For Item 11C - safety glazing material for use in bullet resistant shields, the combined parallel luminous transmittance with perpendicular incident through both the shield and the permanent vehicle glazing is at least 60%.

5.3 Humidity, Test 3.

5.3.1 Purpose of Test. The purpose of this test is to determine whether the safety glass will successfully withstand the effect of moisture in the atmosphere over an extended period of time.

5.3.2 Procedure. Three 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be kept for 2 weeks in a closed container over water. The temperature of the air in the container shall be maintained within the limits of 120°F and 130°F (49°C and 54°C). (These conditions give a relative humidity of about 100%).

5.3.3 Interpretation of Results. No separation of materials shall develop, except for occasional small spots, no one of which shall extend inward from the adjacent edge of the specimen to a depth of more than 1/4-in (6.35 mm).

5.4 Boil, Test 4. (This test is not applicable to multiple glazed units).

5.4.1 Purpose of Test. The purpose of this test is to determine whether the safety glass will successfully withstand exposure to tropical temperatures over an extended period of time.

5.4.2 Procedure. Three 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be immersed, vertically on edge, in water at 150°F (66°C) for 3 minutes and then quickly transferred to and similarly immersed in boiling water. The specimens shall be kept in the boiling water for 2 hours and then removed. The first immersion is intended to reduce the possibility of thermal shock breakage and is optional.

5.4.3 Interpretation of Results. The glass itself may crack in this test, but no bubbles or other defects shall develop more than 1/2 in (13 mm) from the outer edge of the specimen or from any cracks that may develop. Any specimen in which the glass cracks to an extent confusing the result shall be discarded without prejudice, and another specimen shall be tested in its stead.

5.5 Bake, Test 5 (Multiple Glazed Unit Only).

5.5.1 Purpose of Test. The purpose of this test is to determine whether the multiple glazed structure will successfully withstand exposure to tropical temperatures over an extended period of time.

5.5.2 Procedure. The 12- x 12-in (305- x 305-mm), flat specimens of multiple glazed unit after irradiation as specified in Test 1 through 5.1.2 shall be heated to 212°F (100°C) in an oven for 2 hours. If the structure having an air or gas layer between layers of ghss is hermetically sealed, the seal shall be vented.

5.53 **Interpretation** of Results. The glass itself may crack in this test, but no bubbles or other defects shall develop more than 1/2-in (13 mm) from the outer edge of the specimen or from any cracks that may develop. Any specimen in which the glass cracks to an extent confusing the result shall be discarded without prejudice, and another specimen shall be tested in its stead.

5.6 Impact, Test 6 (Ball Drop, 10 ft [3.05m]).

5.6.1 **Purpose** of Test. The purpose of this test is to determine whether the safety glass has a certain minimum strength to resist impact from exterior projectiles such as stones.

5.6.2 Procedure. Twelve 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be rested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each specimen when rested, For each test the specimen tested shall be supported in a maple or similar hardwood frame made in accordance with

[15] See Section 4 and Table 1 for locations in vehicles where glazing material complying with this test is required.

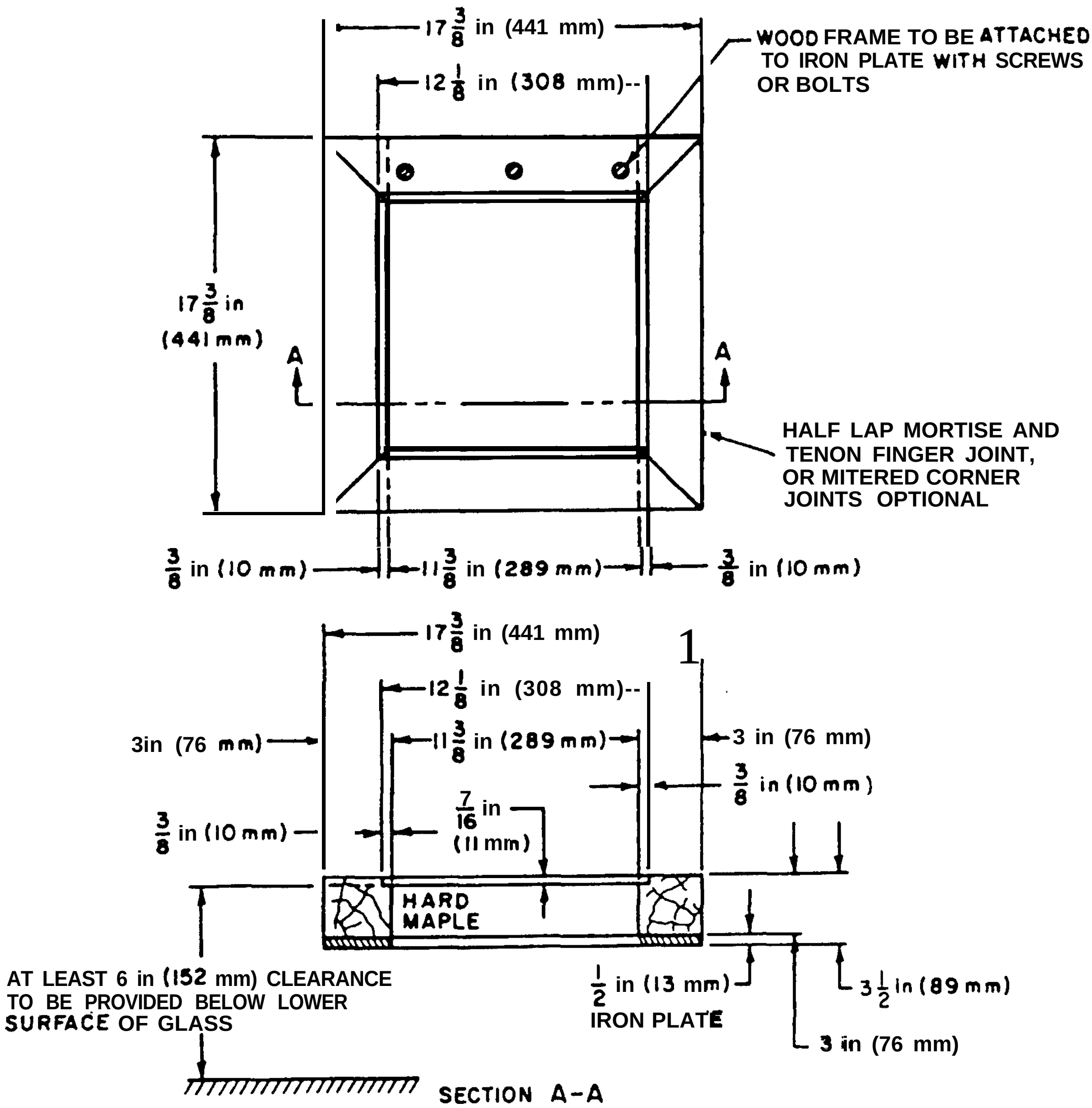


Figure 1
Wood Holding Fixture for Drop Test

Fig. 1. The frame shall be so supported that the plane of the specimen will besubstantially horizontal at the time of impact. A 0.5-pound ± O.l-ounce (224 to 230 grams) smooth, steel sphere shall be dropped 10 ft (3.05 m), once, freely and from rest, striking the specimen within l-in (25 mm) of its center. The steel sphere shall strike the face of the specimen representing the face glazed to the exterior of the vehicle.

5.63 Interpretation of Results. Not more than two specimens shall crack or break as a result of this test. (See also Test 7.)

5.7 Fracture, Test 7.

57.1 Purpose of Test. The purpose of this test is to verify that the fragments produced by fracture of safety glazing materials are such as to minimize the risk of injury.

57.2 Specimens to **be Tested.** Specimens shall be selected from the range of glazing that a manufacturer produces or plans to produce and shall represent the model number considering the following:

(1) Thickness,

(2) Color,

(3) Conductors.

The number of specimens selected from each model number of glazing shall be six (6) and shall all be of the most difficult part or pattern designation within the model number.

5.7.3 Procedure. The specimens to be tested shall not be rigidly secured- Each may be placed horizontally in a support frame or be taped to an identical specimen.

The fracture origin or break-point shall be one (1)-in (25 mm) inboard of the edge at the mid-point of the longest edge of the specimen. In the event that the specimen has two long edges of equal length, the edge nearer the manufacturer's trademark shall be chosen.

To obtain fracture, a spring-loaded center punch or a hammer of about 2.65-ounces (75 gm), each with a point having a radius of curvature of 0.008 ± 0.002-in (0.2 ± 0.05-mm), shall be used.

The areas of three (3)-in (75 mm) radius centered on the point of impact and a strip 3/4-in (20 mm) around the periphery of the specimen shall be excluded from examination.

(Note: Photographic paper may be placed under the test specimen for a permanent record of the fracture pattern.)

5.7.4 Interpretation of Results. No individual fragment free from cracks and obtained within three (3) minutes subsequent to test shall weigh more than 0.15-ounce (4.25 gm).

5.8 Impact, Test 8 (Shot Bag).

5.8.1 Purpose of Test. The purpose of this test is to determine whether the safety glass has a certain minimum strength under impact by a large yielding object representing parts of the body of an occupant of a vehicle.

5.8.2 Procedure. Five 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each specimen when tested- For each test the specimen tested shall be supported in a maple or similar hardwood frame made in accordance with Fig. I. The frame shall be so supported that the plane of the specimen will be substantially horizontal at the time of impact.

An 1 I-lb (4.99 kg) shot bag, made in accordance with Fig. 2, shall be dropped 8 ft (2.44 m), once, freely and from rest, the center of the bottom of the bag striking the specimen within 1 -in (25-mm) of its center. The shot bag shall strike the surface of the specimen which represents the surface that is glazed inward when the glazing is installed in a vehicle.

5.83 **Interpretation** of Results. Not more than one specimen shall crack or break as a result of this test.

5.9 **Impact,** Test 9 (Dart Drop, **30 ft [9.14m]**)

5.9.1 Purpose of Test. The purpose of this test is to determine the behavior of the safety glass under impact from a small, hard object.

5.9.2 Procedure. Five 12- x 12-in. (305- x 305-mm), flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (2 I °C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each sample when tested. For each test the specimen tested shall be supported in a wooden frame made in accordance with Fig. 1. The frames shall be so supported that the plane of the specimen will be substantially horizontal at the time of impact.

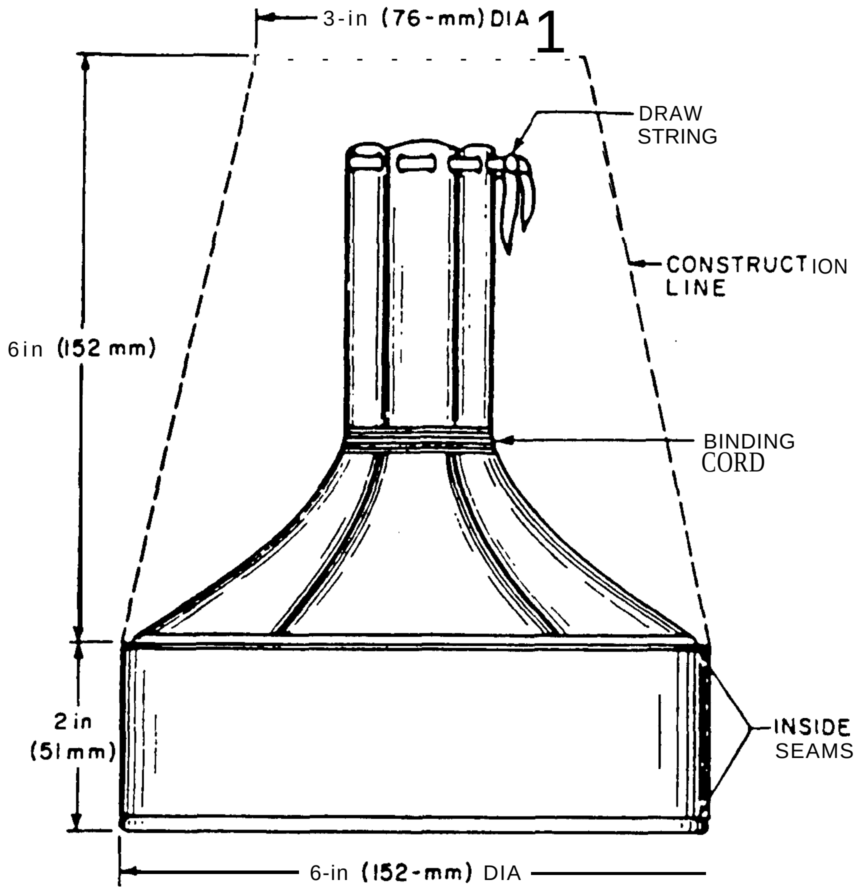
A 7-ounce ± 0.1 -ounce (196- to 20 I -gram) steel dart, made in accordance with Fig. 3, shall be dropped 30 ft (9.14 m), once, freely and from rest, the nose of the dart striking the specimen within l-in (25 mm) of its center on that face that would be glazed to the outside of the vehicle.

5.93 **Interpretation** of Results. The dart may crack the glass and may puncture the test specimen. However, the hole so produced in the specimen shall not be sufficiently large to permit passage of the body of the dart completely through the test specimen. Small particles may disengage themselves from both sides of the specimen at and immediately around the point of impact, but no loose or detached pieces shall leave any area of the specimen exclusive of rhe area punctured by the dart. Furthermore, the glass on adjacent sides of each crack extending from the area punctured by the dart shall be held in place by the reinforcing or strengthening material, and no glass shall be freed from reinforcing or strengthening material for a distance greater than 1-1/2-in (38 mm) fromacrack. Spalling of the outer glass surface opposite the point of impact and adjacent to the area of impact is not to be considered a failure. Not more than one specimen shall break into separate large pieces.

5.10 Impact, Test **10** (Dart Drop, **Table** 2 **Heights).**

5.10.1 Purpose of Test. The purpose of this test is to determine the behaviorof rhe plastic under impact from a small, hard object.

5.10.2 **Procedure.** Five 12- x 12-k (305- x 305-mm), flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C



NOTE: Bag to be made of 1/32-in (0.79-mm) thick flexible leather. Use lead shot, BB size (4.57 mm in diameter). Total weight of bag and shot to be 11-lb ± 1 oz (4.961 to 5.018 kg).

Figure 2
11-lb (4.99-kg) Shot-Bag Safety Glass Tests

to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each specimen when tested. For each test the specimen tested shall be supponed in a wooden frame made in accordance with Fig. 1. The frame shall be so supported that the plane of the specimen will be substantially horizontal at the time of impact.

A 7-ounce ± 0.1 -ounce (196- to 201-gram) steel dart, made in accordance with Fig. 3. shall be dropped from a height in accordance with Table 2, once, freely and from rest, the nose of the dart striking the specimen within l-in (25 mm) of its center.

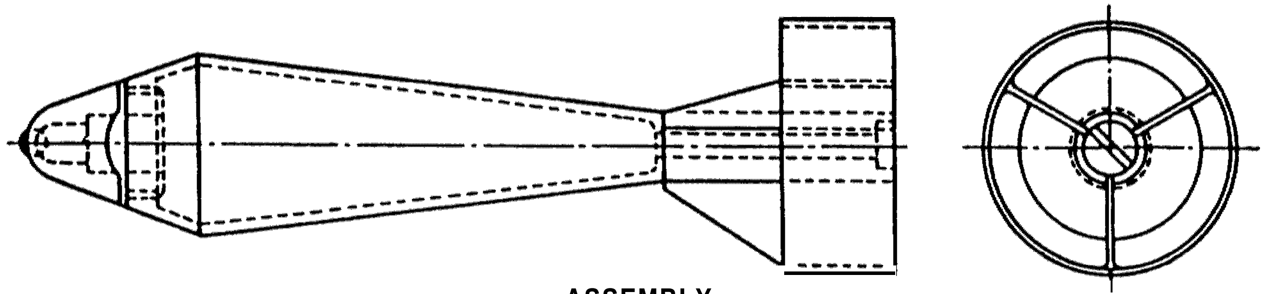
5.103 Interpretation of Results. The dart may crack or puncture the test specimen, but not more than one specimen shall break into separate large pieces.

At the point immediately opposite the point of impact, small fragments of plastic may leave the specimen, but if laminated the small area thus affected shall expose less than 1 in^2 (645 mm^2) of reinforcing or strengthening material, the surface of which shall always be well covered with particles of tightly adhering plastic. Total separation of plastic from the reinforcing or strengthening material shall not exceed 3 in^2 (1935 mm^2) on either side.

5.11 Impact, Test 11 (Dart Drop, 10 ft (3.051).

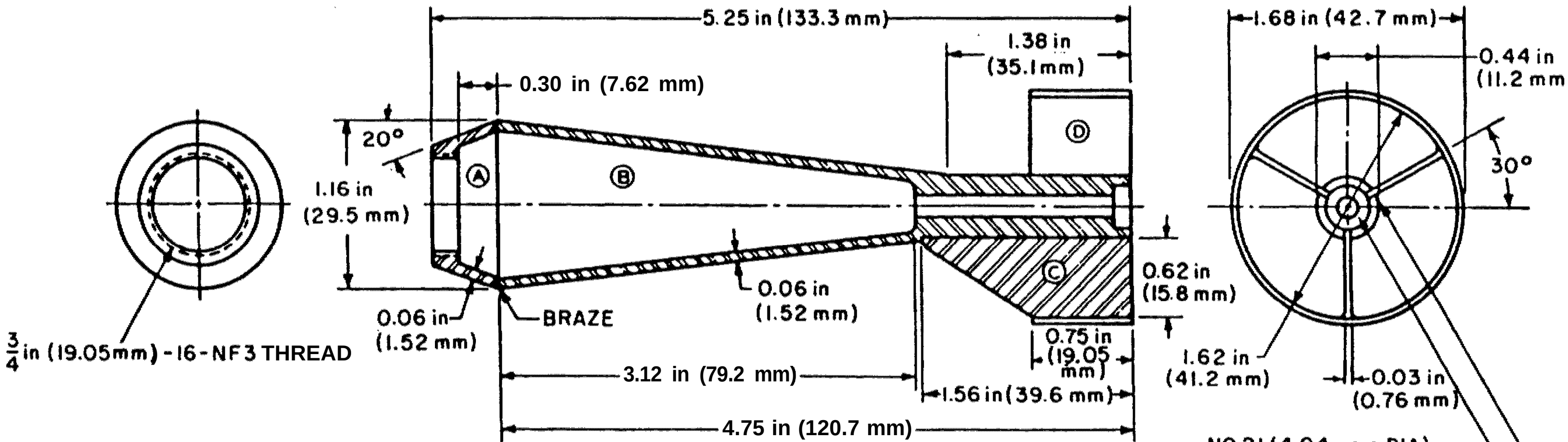
5.11.1 Purpose of Test. The purpose of this test is to determine the behavior of wired glass under impact from a small, hard object.

5.11.2 Procedure. Five 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each sample when tested. For each test the specimen tested shall be supported in a maple or similar hardwood frame made in accordance with Fig. 1. The frame shall be so supported that the plane of the specimen will bc substantially horizontal at the time of impact.



ASSEMBLY

WEIGHT: 7 oz ± 0.1 oz (196 TO 201 g) (ADJUST WITH LEAD SHOT)



DETAIL 1 - BODY

1 - WELDER CONSTRUCTION

STOCK 1-PIECE (A) 1 3/8-in (34.9-mm) DIA MACHINE STEEL

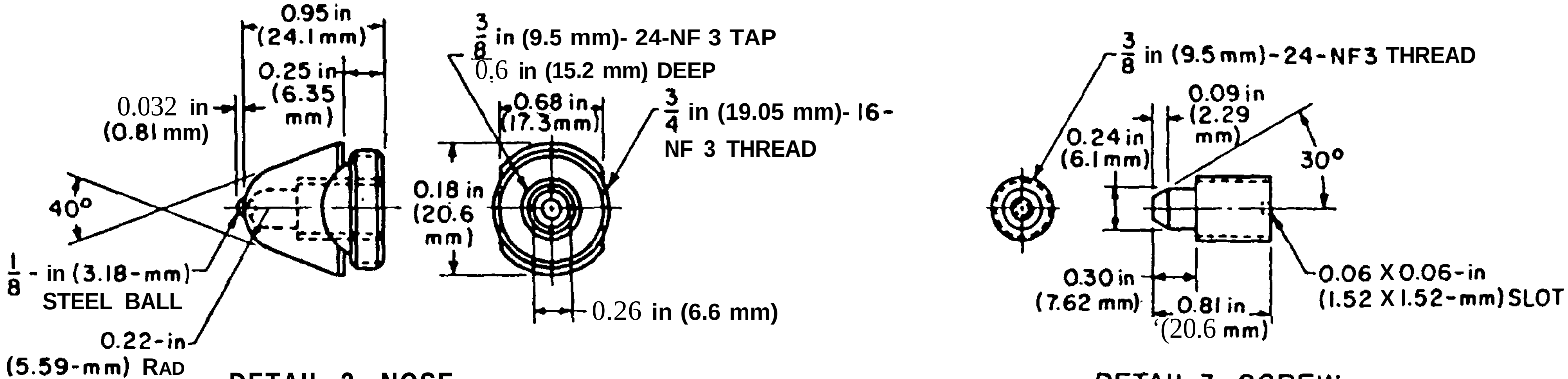
1- PIECE (B) 1 3/8-in (34.9-mm) DIA MACHINE STEEL

3 PIECES (C) NO.21 GAGE (0.0329-in) (0.836-mm) SHEET STEEL

1 - PIECE (D) 1 1/2-in (38.1-mm) EXTRA-HEAVY PIPE

NOTE: Not to scale.

(*Continued on next page*)



DETAIL 2 -NOSE
AISI TYPE A-6 STEEL
STOCK 1.0-in (25.4 mm) DIAMETER
HEAT TREATMENT : AUSTENIZE
AIR COOL, TEMPER TO ROCKWELL 52-56C

DETAIL 3-SCREW
AISI TYPE A-6 STEEL
STOCK 1/2-in (1. 27-mm) DIAMETER
HEAT TREATMENT : AUSTENIZE
AIR COOL, TEMPER TO ROCKWELL 58-62C

NOTE: Not to sale.

Figure 3
Dart for Safety Glass Tests

A 7-ounce ± 0.1-ounce (196- to 201-gram) steel dart, made in accordance with Fig. 3, shall be dropped 10 ft. (3.05 m), once, freely and from rest, the nose of the dart striking the specimen within 1-in (25 mm) of its center.

5.113 **Interpretation of Results.** The dart may crack the glass and may puncture the test specimen, and small particles may disengage themselves from both sides of the specimen at and immediately around the point of impact, but no loose or detached pieces shall leave any area of the specimen exclusive of the area punctured by the dart. Furthermore, the glass on adjacent sides of each crack extending from the area punctured by the dart shall be held in place by the reinforcing or strengthening material, and no glass shall be freed from reinforcing or strengthening material for a distance greater than 1-1/2 in (38 mm) from a crack.

Table 2
Height of Drop for Ball and Dart Impact Tests of Plastic Specimens*

Nominal Thickness of Plastic Specimen		Height of Drop	
Inches	**Millimeters**	**Feet**	**Meters**
0.125 or less	3.18 or less	6	1.83
0.150	3.81	9	2.74
0.187	4.75	12	3.66
0.220	5.59	15	4.57
0.250 or more	6.35 or more	18	5.49

* For the purpose of determining the height of drop to be used, thickness of the plastic specimen measured 1-in (25 mm) from the edge at any point shall not differ from the nominal thicknesses given in the table. The height of drop for materials of nominal thicknesses between those listed in the table shall be calculated proportionately to the adjacent values given in the table.

5.12 Impact, Test 12 (Ball Drop, 30 ft [9.14 m])

5.12.1 Purpose of Test. The purpose of this test is to determine whether the safety glass has a certain minimum strength and whether it is properly made.

5.12.2 Procedure. Twelve 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each sample when tested. For each test the specimen tested shall be supported in a maple or similar hardwood frame made in accordance with Fig. 1. The frame shall be so supported that the plane of the specimen will be substantially horizontal at the time of impact.

A 0.5-pound ± 0.1-ounce (224- to 230-gram) solid, smooth steel sphere shall be dropped 30 ft. (9.14 m), once, freely and from rest, striking the specimen within 1-in (25 mm) of its center on the face that would be glazed to the outside of the vehicle. The ball shall be allowed to make only one impact with the specimen.

5.123 Interpretation of Results. The impact may produce a large number of cracks in the glass; not more than two of the specimens shall break into separate Large pieces. Furthermore, with no more than two of the remaining specimens shall the ball produce a hole or fracture at any location in the specimen through which the ball will pass.

At the point immediately opposite the point of impact, small fragments of glass may leave the specimen, but the small area thus affected shall expose less than 1 in^2 (645 mm^2) of reinforcing or strengthening material, the surface of which shall always be well covered with tiny particles of tightly adhering glass. Total separation of glass from the reinforcing or strengthening material shall not exceed 3-in^2 (1935 mm^2) on either side.

Spalling of the outer glass surface opposite the point of impact and adjacent to the area of impact is not to be considered a failure.

5.13 Impact, Test 13 (Ball Drop, Table 2 Heights).

5.13.1 Purpose **of Test.** The purpose of this test is to determine whether the plastic has a certain minimum strength and whether it is properly made.

5.13.2 Procedure. Twelve 12- x 12-in (305- x 305-mm), flat specimens, as submitted, shall be tested, Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21°C to 29°C) for at least 4 hours immediately preceding the test, thereby ensuring a uniform temperature throughout each sample when tested. For each test the specimen tested shall be supported in a wooden frame made in accordance with Fig. 1. The frame shall be so supported that the plane of the specimen will be substantially horizontal at the time of impact.

A 0.5-pound ± 0.1-ounce (224- to 230-gram) solid, smooth steel sphere shall be dropped from a height in accordance with Table 2, once, freely and from rest, striking the specimen within 1-in (25 mm) of its center on the face that would be glazed to the outside of the vehicle. The ball shall be allowed to make only one impact with the specimen.

5.133 Interpretation of Results. The impact may produce cracks in the plastic; not more than two of the specimens shall break into separate large pieces, nor shall more than two of the remaining specimens develop a fracture that can be described as a hole through the body of the specimen.

At the point immediately opposite the point of impact, small fragments of glass may leave the specimen, but if laminated, the small area thus affected shall expose less than 1 in^2 (645 mm^2) of reinforcing or strengthening material, the surface of which shall always be well covered with tiny particles of tightly adhering plastic. Total separation of plastic from the reinforcing or strengthening material shall not exceed 3 in^2 (1935 mm^2) on either side.

5.14 Impact,Test 14 (Ball Drop, Variable) (Multiple Glazed Unit, Class 2, Only)

5.14.1 Purpose of Test. The purpose of this test is to determine whether the glazed units have a certain minimum strength and whether they are properly made.

5.14.2 Procedure. Twelve 12- x 12-in (305- x 305-mm), flat specimens of multiple glazed units of Class 2, as submitted, symmetrical in construction rather than in shape, shall be tested inaccordancewith the technique of Test 12andthe testcontinued to fracture of all component layers other than reinforcing or strengthening material in an interlayer. The weight of the ball or the height of drop, or both, may be increased to effect fracture of all component layers other than reinforcing or strengthening material in an interlayer.

Twenty-four 12- x 12-in (305- x 305-mm), flat specimens of multiple glazed units of Class 2, as submitted, nonsymmetrical in construction rather than in shape, shall be tested on both sides, using a separate sample for impacting opposite sides.

5.143 Interpretation of Results. Nosinglefragmentofglazing material free from cracks or separated from reinforcing or strengthening material shall exceed 2 in^2 (1290 mm^2) in area.

5.15 Optical Deviation and Visibility Distortion, Test 15

5.15.1 Purpose of Test. The purpose of this test is to measure the optical deviation and visibility distortion effects of flat or curved safety glazing materials or both. To this end, the procedure is divided into two parts: Optical Deviation (5.15.2.1) and Visibility Distortion (5.15.2.2).

5.15.2 Procedure. Ten 12- x 12-in (305- x 305-mm), flat specimens of the safety glazing material and in the case of curved glazings, three approximately 12- x 12-in (305- x 305-mm) additional curved specimens as described in Section 3, Specimens to Be Tested, curved to the minimum radius shall be tested for optical deviation (see 5.15.2.1) and visibility distortion (see 5.15.2.2) before being subjected to other tests. That area of each specimen within l-in (25.4 mm) of any edge shall be covered with a suitable opaque mask.

5.15.2.1 Optical Deviation. Theequipmentforthistestconsists of the illuminated box as shown in Fig. 4. The illuminated box shall be placed in a dark or semidark room so that the secondary image and the white circle shall be distinctly visible. The specimen shall be placed 25 ft (7.62 m) from the face of the box and positioned so that the area of the specimen being examined will be normal to the line of vision between the light source and the examiner's eye (one eye only). The entire unmasked area of the specimen shall be surveyed. In testing of unsymmetrical glazing materials, such as glass-plastic laminates, the outboard surface of the specimens shall face the illuminated box.

5.15.2.2 Visibility Distortion. The equipment for this test consists of:

(1) A good quality, 500-watt, lantern slide projector or a similar assembly of light source and lenses that is capable of projecting a sharply defined image on a screen at a distance of 25 ft (7.62 m). The objective lens of this system shall have an aperture approximately 2-in (51 mm) in diameteranda focal length of 12 in (305 mm). The light source shall be not less than 500 watts rating.

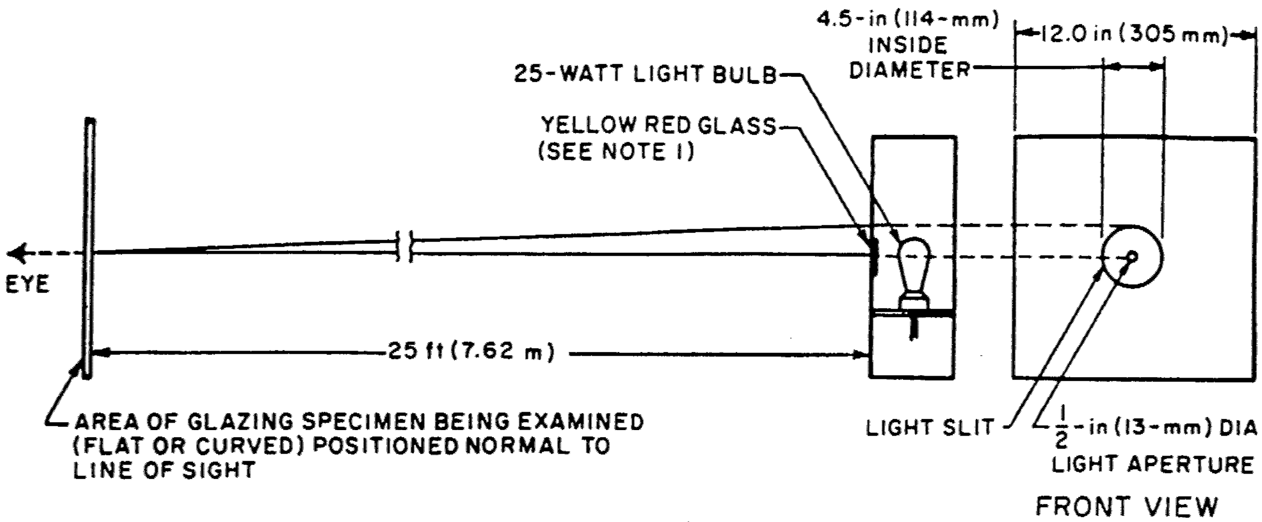
(2) A square, clean, nongloss, white projection screen that lies substantially in one plane, measuring approximately 5 ft (1.62 m) on a side.

(3) A darkroom of sufficient length to accommodate the setup.

The projection lantern shall be focused on the screen 25 ft (7.62 m) distant. The specimen shall be placed between the lantern and the screen, close to and as nearly parallel with the screen as may be possible. The specimen shall be positioned so that the outboard surface faces the screen. The specimen shall be moved toward the lantern in steps of 5-in (127 mm), always as nearly parallel to the screen as may be possible, and the shadow on the screen observed When light and dark patches begin to appear throughout the entire area of the shadow, the distance from the screen to the specimen shall be noted The entire unmasked area of the specimen shall be surveyed.

5.15.3 Interpretation of Results. Throughout the area surveyed under 5.15.2.1. there shall be no shift of the secondary image beyond the point of tangency with the inside edge of the circle.

NOTE: An image shift to the point of tangency of the inside edge of the 4.5-in (114-mm) circle represents a direct vision deviation of 3.95 minutes of arc or 0.35-in (8.9 mm) at 25 ft (7.62 m).



NOTES:
(1) Such as Corning Number 3480 or the equivalent.
(2) Not to scale.

Figure 4
Double-Image Method (Test 15)

Under 5.15.2.2, no light and dark patches, existent over the entire area, shall appear in the shadow of the unmarked area of the specimen before the specimen shall have been moved a distance of a least 25-in (635 mm) from the screen.

Failure to comply with both 5.15.2.1 and 5.15.2.2 shall be construed as noncompliance with the requirements of this test.

5.16 Weathering, Test 16

5.16.1 Purpose of Test. The purpose of this test is to determine whether the plastic or glass-plastic laminate glazing will successfully withstand exposure to simulated weather conditions over an extended period of time.

5.16.2 Procedure[16]

5.16.2.1 Apparatus. The light source shall be a carbon arc including the carbons and light filters regularly supplied with the apparatus that is used or specified.

Single and twin arc apparatus[17] shall, if for alternating current, be operated with a combination of what are commercially known as Number 70 solid carbons and Number 20 cored carbons. For direct current, Number 70 carbons shall be used in both upper and lower holders. These carbons shall be 1/2-in (12.7 mm) in diameter and 12-in (305 mm) in length and shall produce what is commercially known as Violet Arc.

The apparatus shall include equipment necessary for measuring and controlling the following:

(1) Current

(2) Voltage

(3) Temperature of panels

(4) Water spray

(5) Operating schedule or cycle

5.16.2.2 Method of Test. Three specimens size 2- x 6-in (51- x 152-mm) shall be tested for regular (parallel) luminous transmittance (International Commission on Illumination "Illuminant A") at normal incidence.

[16] According to ASTM D 1499-64 (1977) and ASTM G 23-81.
[17] Such as Atlas Single Arc, Atlas Twin Arc, or the equivalent.

These specimens shall then be exposed with their outboard surfaces facing the light source for 1000 hours as follows:

(1) The light sources shall be operated within the following limits:

(a) For single and twin arc apparatus (alternating current) the average for each trim or burning period shall be 135 volts ± 2% and 16 amperes ± 2% at the arc. During the burning period, the voltage may vary between 125 and 145 volt-s and the current between 15 and 18 amperes.

(b) For single and twin arc apparatus (direct current) the average for each trim or burning period shall be 135 volts ± 2% and 12 amperes ± 2% at the arc. During the burning period, the voltage may vary between 130 and 145 volts and the current between 11 and 13 amperes.

(2) Filters (globes and windows) shall be replaced after 2000 hours of use, or when pronounced discoloration or milkiness develops, whichever occurs first. Filters shall be cleaned each day by washing with detergent and water.

(3) The temperature within the apparatus shall be controlled by the circulation of sufficient air to produce a black panel temperature of 145°F ± 5°F (60°C to 66°C) when measured by a standard black-painted panel with a suitable thermometer embedded in the surface. This panel shall be mounted in the test panel rack and readings shall be taken in a position where the water spray is not striking the panel and at the point where maximum heat is developed due to light exposure.

(4) The water shall strike the test panels in the form of a fine spray under a pressure of 25 to 30 psi (172 to 207 kPa) at the nozzle and in sufficient volume to wet the panels immediately upon impact. No recirculation of the spray water or immersion of the test panels in the spray water shall be permitted.

(5) The water used shall be clean and shall not deposit materials to an objectionable degree on the test panels.

(6) The pH of the water shall be between 6.0 and 8.0.

(7) The temperature of the water in the line where it enters the apparatus shall be 60°F ± 10°F (10°C to 21°C).

(8) The test panels shall be rotated about the arc in order to provide uniform distribution of the light. If the test panels are mounted vertically both above and below the horizontal centerline of the light source, their position shall be transposed once each day the apparatus is in operation to provide uniform distribution of the light in a vertical plane over the entire face of the panel. Products of combustion shall not be permitted to come in contact with the test panels.

(9) Unless otherwise specified, the apparatus shall be operated 5 days of each week according to a schedule consisting of ten Z-hour cycles (20 hours) per day. Each 2-hour cycle shall be divided into periods during which the test panel shall be exposed to light without water spray for 102 minutes and to light with water spray for 18 minutes. The test panels shall remain undisturbed in the apparatus during the 2 days when the apparatus is not operating.

NOTE: This operating schedule is intended to combine light and water spray exposure in a way that permits operation of carbon-arc type apparatus that are in common use on the same schedule, in order to promote better correlation between laboratories. A rest period is included as a desirable part of this particular schedule. The use of this schedule is not necessarily to be considered as preferable to any other schedule that combines the effects of light alone, light and water, water alone, and rest periods in a sequence that produces desirable results.

The irradiated specimens shall again be tested for regular (parallel) luminous transmittance (International Commission on Illumination "Illuminant A") at normal incidence.

5.16.3 Interpretation of Results. The decrease in regular (parallel) luminous transmittance of the irradiated specimens shall not exceed 5%. Any increase in regular (parallel) luminous transmittance is acceptable. Some discoloration may develop, but defects other than this discoloration shall not develop. No bubbles or other noticeable decomposition shall develop in the irradiated portion.

5.17 Abrasion Resistance, Test 17 (Plastics).

5.17.1 Purpose **of Test.** The purpose of this test is to determine whether the plastic has a certain minimum resistance to abrasion.

5.17.2 Procedure.

5.17.2.1 Apparatus.

(1) The apparatus for the abrasion shall be the Taber Abraser[18] or its equivalent. A load of 500 grams shall be employed on each wheel.

(2) The fine side of a Taber ST-11 refacing stone or disk and a refacing disk holder shall be used for resurfacing the abrasive wheels. It is important that the holder runs true on the abraser and that the refacing stone or disk lies flat on the holder.

(3) An abrasive wheel[19] meeting the following requirements at the time of the test shall be used:

(a) The wheel shall not be used after the date stamped on it

(b) The durometer hardness[20] of the wheel shall be measured on at least four points equally spaced on the center of the abrading surface- The test shall be made with the pressure applied vertically along a diameter of the wheel, and reading taken 10 seconds after full application of the pressure. Each wheel shall have a durometer hardness of 72 ± 5.

(c) New wheels shall be broken in by 100 revolutions on the ST-11 refacing stone or disk followed by 500 revolutions on the material to be tested, followed by 25 revolutions on the ST-11 refacing stone or disk prior to starting the test on the specimen.

(4) The turntable of the abraser shall rotate substantially in a plane with a deviation at the distance of 1/16-in (1.59 mm) from its periphery of not greater than ± 0.002-in (±0.05 mm).

(5) An integrating sphere, photoelectric photometer[21] constructed essentially as shown in Fig. 5 or 6 and conforming to the requirements shown below shall be used to measure the light scattered by the abraded track. A diaphragm shall be centrally inserted in the haze-measuring apparatus to center the light beam on the abraded track and limit it to a diameter of 7 mm ± 1 mm at the specimen. If haze measurements are made with other devices or by other methods, a correlation shall be established with the results obtained with the apparatus and method described as follows:

(a) An integrating sphere shall be used to collect transmitted flux; the sphere may be of any diameter so long as the total port area does not exceed 4.0% of the internal reflecting area of the sphere.

(b) Figs. 5 and 6 indicate possible arrangements of the apparatus. The entrance and exit ports shall be centered on the same great circle of the sphere and there shall be at least 170 degrees of arc between centers. The exit port shall subtend an angle of 8 degrees at the center of the entrance port. The axis of the irradiating beam shall pass through the centers of the entrance and exit ports. The photocells shall be positioned on the sphere 90 degrees ± 10 degrees from the entrance port. In the pivotable modification of this type (Fig. 6) designed to use the interior sphere wall adjacent to the exit port as the reflectance standard, the angle of rotation shall not exceed 10 degrees.

(c) The specimen shall be illuminated by a substantially unidirectional beam; the maximum angle that any ray of this beam makes with the direction of its axis shall not exceed 3 degrees. This beam shall not be vignetted at either port of the sphere.

(d) When the specimen is placed immediately against the integrating sphere at the entrance port- the angle between the normal to its surface and the axis of the beam shall not exceed 8 degrees.

(e) When the beam is unobstructed by a specimen, its cross section at the exit port shall be approximately circular, sharply defined and concentric within the exit port leaving an annulus of I.3 degrees ± 0.1 degrees subtended at the exit port.

(f) The surfaces of the interior of the integrating sphere, baffles, and reflectance standard shall be of substantially equal reflectance, matte, and highly reflecting throughout the visible wavelengths. Freshly smoked magnesium oxide is excellent for this purpose, but highly reflecting matte paints are more durable.

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[18] According to ASTM D 1044-82.
[19] Such as a Calibrase CS-10F-81 wheel or the equivalent.
[20] According to ASTM D 2240-81.
[21] According to ASTM D 1003-61 (1977).

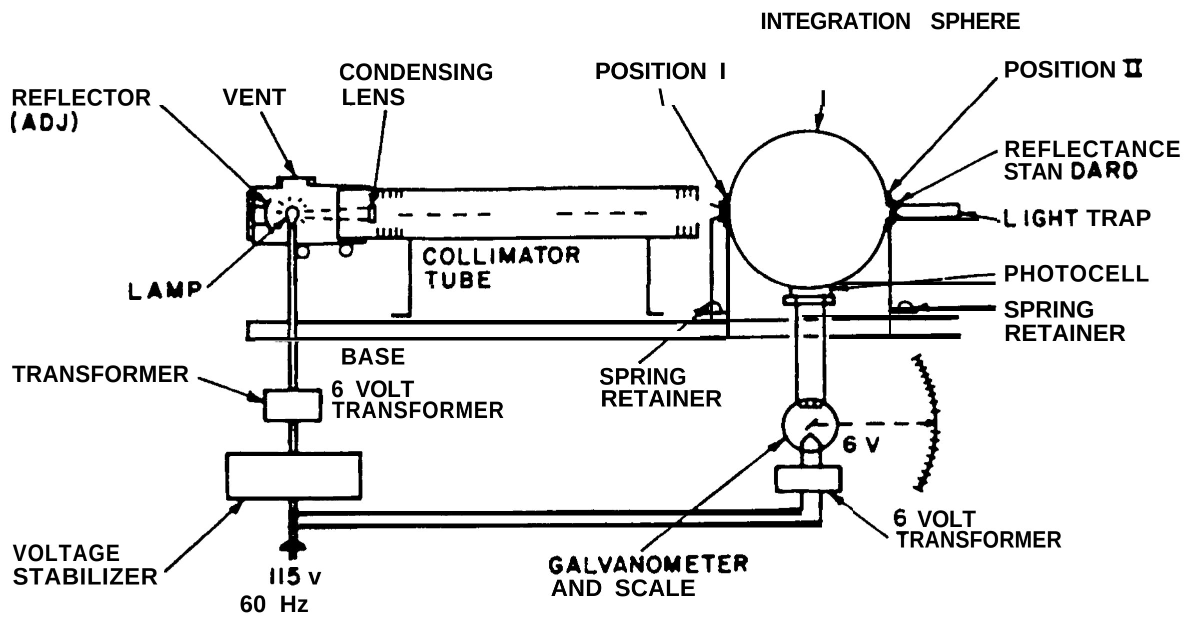


Figure 5
Hazemeter

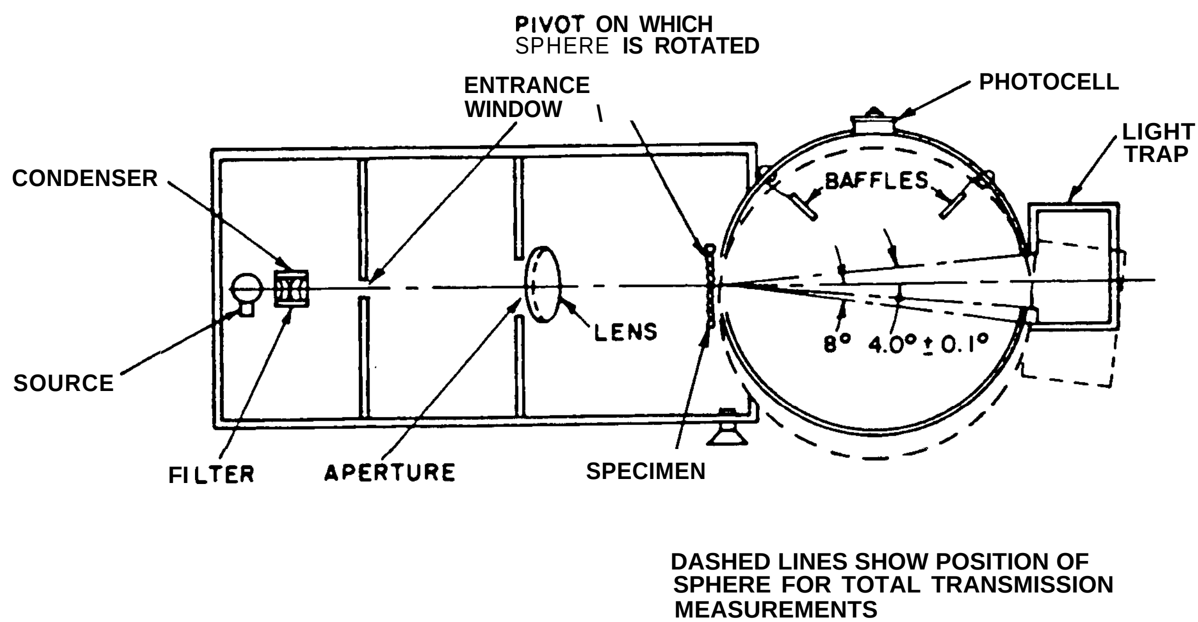


Figure 6
Pivotable-Sphere Hazemeter

(g) For some measurements the standard at the exit port is replaced by a light trap by actual removal of the reflectance standard or by pivoting the sphere (Fig. 6). The light trap shall absorb the beam completely when no specimen is present.

(h) The radiant flux within the sphere shall be measured by a photoelectric cell, the output measurements of which shall be proportional within 1% to the incident flux over the range of intensity used. Spectral conditions for source and receiver shall be constant throughout the test of each specimen. The design of the instrument shall be such that there shall be no galvanometer deflection when the sphere is dark.

(i) Determine the four readings given in Table 3.

(j) Repeat readings for T_1, T_2, T_3, and T_4 with additional specified positions of the specimen to determine uniformity.

(k) Calculate total transmittance T_t equal to T_2/T_1.

(l) Calculate diffuse transmittance T_d as follows:

$$T_d = \frac{T_4 - T_3 (T_2/T_1)}{T_1 - T_3}$$

(m) Calculate percentage haze or light, or both, scattered as follows:

Haze or light, or both, scattered,

$$\text{percent} = \frac{T_d}{T_t} \times 100$$

5.17.2.2 Test **Specimens.**

(1) Three 4- x 4-in (102- x 102-mm), flat specimens, as submitted, having both surfaces substantially plane and parallel, shall be tested.

(2) Prior to testing, any protective masking material shall be removed, and the specimens shall be cleaned by a practice recommended by the manufacturer.

(3) After cleaning, the specimens shall be handled only by their edges and shall be stored in a suitable rack or in clean envelopes to prevent damage to, or contamination of, their surfaces.

5.17.2.3 Conditioning of Specimens. The specimens shall be conditioned prior to testing for a minimum time of 4X hours at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity.[22]

5.17.2.4 Method of Test. The test method shall be as follows:

(I) Level the Taber Abraser.

(2) The pair of abrasive wheels to be used shall be mounted on their respective flange holders (see Note), taking care not to unduly handle them by their abrasive surfaces. The load to be used is 500 grams on each wheel.

NOTE: The wheels are marked "righthand" and "lefthand."

(3) Using the refacing disk holder and the fine side of an ST-1 I refacing stone, reface the wheel 25 cycles previous to abrading each specimen.

(4) Measure the initial haze of the specimen at a minimum of four equally spaced points in the unabraded area in

Table 3
Transmittance **Readings for Abrasion Resistance** Test

Reading Designation	**Specimen** in **Position**	Light Trap in **Position**	**Reflectance Standard** in **Position**	**Quantity Represented**
T_1	No	No	Yes	Incident light
T_2	Yes	No	Yes	Total light transmitted by specimen.
T_3	No	Yes	No	Light scattered by instrument.
T_4	Yes	Yes	No	Light scattered by instrument and specimen.

[22] According to ASTM D 618-61 (1981).

accordance with 5.17.2.1 (5) (m). The results shall be averaged for each specimen. In lieu of the four measurements, an average value may be obtained by rotating the specimen at three or more revolutions per second.

(5) The specimen shall be mounted on the specimen holder so that it rotates substantially in a plane and subjected to abrasion for 100 cycles. Specimens shall be carefully wiped after abrasion with dry lens paper (or its equivalent).

(6) Measure the light scattered by the abraded track at a minimum of four equally spaced points along the track in accordance with 5.17.2.1 (5) (m). The results shall be averaged for each specimen. In lieu of the four measurements, an average value may be obtained by rotating the specimen at three or more revolutions per second.

The average initial haze determined by 5.17.2.4(4) shall be subtracted from the average total light scattered as measured by 5.17.2.4(6), the difference representing the light scatter resulting from abrading the specimen.

5.173 Interpretation of Results. The arithmetic mean of the percentages of light scattered by the three specimens as a result of abrasion shall not exceed 15.0%. For glass plastic specimens, the arithmetic mean of the percentages of light scattered, on the plastic surface facing inward, by the three specimens as a result of abrasion shall not exceed 4%.

5.18 Abrasion Resistance, Test 18 (Safety Glass).

518.1 Purpose of Test. The purpose of this test is to determine whethersafetyglass has a certain minimum resistance toabrasion.

5.18.2 Procedure. The procedure for this test shall be that described in Test 17 except that the specimens of safety glazing material for this test are to be subjected to abrasion for 1000 cycles. Three 4- x 4-in (102- x 102-mm), flat specimens shall be tested.

5.183 Interpretation of Results. The arithmetic mean of the percentages of light scattered by the three specimens as a result of abrasion shall not exceed 2.0%.

5.19 Chemical Resistance, Test 19 (Nonstressed).

5.19.1 Purpose of Test. The purpose of the test is to determine whether nonstressed transparent plastic or glass-plastic laminate glazing will have a certain minimum resistance to the following chemicals,[23] which are likely to be used for cleaning purposes in motor vehicle service

(1) A 1% solution of a nonabrasive soap

(2) Kerosene

(3) Undiluted denatured alcohol (Formula SD No. 30)[24]

(4) Commercial motor car gasoline (- to be defined).

(5) An aqueous solution of isopropanol and glycol ether solvents in concentration no greater than 10% or less than 5% by weight each and ammonium hydroxide no greater than 5% or less than 1% by weight each, simulating typical commercial windshield cleaner.

5.19.2 Procedure. Two 1- x 7-in (25- x 178-mm), flat specimens, as submitted, shall be tested with each of the chemicals prescribed in 5.19.1 usinganewspecimenforeach test with each chemical. Prior to testing, any protective masking material shall be removed and the specimen shall be cleaned by a practice recommended by the manufacturer.

Test specimens shall be conditioned prior to testing for a minimum time of 48 hours at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity. The tests shall be conducted in an atmosphere maintained at 7 1°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity. Specimens shall be completely immersed in the fluid being tested, held for 1 minute, removed, immediately wiped with absorbent cotton, and examined for evidence of softened or tacky surfaces.

5.193 Interpretation of Results. There shall be no tackiness, crazing, or apparent loss of transparency in the samples. For glass plastic specimens only the plastic surface facing inward is subject to test and evaluation.

5.20 Chemical Resistance, Test 20 (Stressed)

520.1 Purpose of Test. The purpose of this test is to determine whether stressed plastic will have a certain minimum resistance to the following chemicals,[23] which are likely to be used for cleaning purposes in motor vehicle service:

(1) A 1% solution of a nonabrasive soap

[23] Caution should be observed in the use of these materials, some of which arc toxic.

[24] One part 100% methyl alcohol in 10 parts 190-proof cthyl alcohol by volume.

(2) Kerosene

(3) Undiluted denatured alcohol (Formula SD No. 30)[24]

(4) Commercial motor gas gasoline (—— to be defined)

5.20.2 Procedure. Two 1- x 7-in (25- x 178-mm), flat specimens, as submitted, shall be tested with each of the chemicals prescribed in 5.20.1 using a new specimen for each test with each chemical. Prior to testing, any protective masking material shall be removed and the specimen shall be cleaned by a practice recommended by the manufacturer.

Test specimens shall be conditioned prior to testing for a minimum of 48 hours at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity. The tests shall be conducted in an atmosphere maintained at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity.

The specimens shall be set up as a Class I lever with the fulcrum 2-in (51 mm) from the stationary end and a load suspended at a 4-in (102-mm) overhang from the fulcrum. This load in pounds (grams) shall be equal to $41.7t^2$ ($29.3t^2$) where t = thickness in inches (millimeters) that will produce an outer fiber stress of 1000 psi (6895 kPa) in the plastic at the fulcrum point. While the specimen is stressed, one of the prescribed chemicals shall be applied to the top surface of the specimen above the fulcrum point. The chemical shall be applied with a soft, 1/2-in (13-mm) wide brush, wet before each stroke. Ten individual strokes at 1-second intervals across the width of the specimen shall be required. One minute after the last stroke the specimen shall be wiped dry with clean absorbent cotton and immediately examined for any evidence of surface defects, cracks, or crazing while the sample is maintained in the loaded state.

5.20.3 Interpretation of Results. There shall be no tackiness, crazing, or apparent loss of transparency in the samples.

5.21 Dimensional Stability, Test 21 (Warpage).

5.21.1 Purpose of Test. The purpose of this test is to determine whether excessive shape changes occur in plastics under conditions of high atmospheric temperature and humidity.

5.21.2 Procedure. Two 6- x 6- x 1/4-in (152- x 152- x 6.35-mm), flat specimens, as submitted, edge-finished, shall be tested. Prior to testing, any protective masking material shall be removed and the specimens cleaned by a practice recommended by the manufacturer.

Prior to testing, the specimens shall be conditioned on a plane glass-plate surface for a minimum time of 48 hours at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity.

The conditioned specimens shall be measured for initial "off-flatness" by determining the greatest distance from a straight edge connecting diagonally opposite corners to the near surface of the plastic. This distance may be measured by means of a dial micrometer, thickness gage, or any other device having an accuracy of 0.001-in (0.03 mm).

The conditioned and measured specimens, placed on the plane glass-plate surfaces in the same orientation in which they were conditioned, shall be exposed for 24 hours at 160°F (71°C) and 70% to 75% relative humidity. Following this the specimen shall be immediately transferred, while on the plane glass-plate surface, to another container maintained at 70% to 75% relative humidity and 71°F to 75°F (22°C to 24°C) and held for 2 hours. The specimen shall be removed to a 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity atmosphere, wiped dry, and immediately remeasured for warpage by determining the greatest distance of the surface of the plastic from a straight edge connecting diagonally opposite corners. Warpage shall be reported as the greatest increase in deviation from flatness in any of the specimens tested.

5.21.3 Interpretation of Results. The maximum warpage shown by any of the specimens shall not exceed 0.050-in (1.27 mm).

5.22 Flexibility, Test 22

5.22.1 Purpose of Test, The purpose of this test is to determine whether plastics have satisfactory flexibility.

5.22.2 Procedure. Two 10- x 2.5-in (254- x 64-mm), flat specimens, as submitted, shall be tested. Prior to testing, any protective masking material shall be removed and the specimens cleaned by a practice recommended by the manufacturer. Prior to testing, the specimens shall be conditioned for a minimum time of 48 hours at 71°F to 75°F (22°C to 24°C) and 50% ± 2% relative humidity. After conditioning, the test specimens shall be immediately bent over a mandrel so that the entire length of the specimen shall conform to the surface of the mandrel, or it shall be bent 180 degrees over the mandrel, with the longitudinal axis of the specimen normal to the axis of the mandrel. The diameter of the mandrel shall be equal to 80 times the thickness of the plastic material being tested.

[24] One part 100% methyl alcohol in 10 parts 190-proof ethyl alcohol by volume.

5.223 Interpretation of Results. The plastic shall show no cracks, wrinkles, or surface impairment during or after bending.

5.23 Flammability, Test 23 (0.050-in [I.27 mm] or Less in Thickness)

5.23.1 Purpose of Test. The purpose of this test is to determine the rate of burning of plastics, 0.050-in (1.27 mm) or less in thickness.

5.23.2 Procedure. Six 12-1/2- x I-in (318- x 25-mm), flat specimens, as submitted, shall be tested. The test specimen shall be marked into squares 1/2-in (13 mm) on a side before the test is started. This marking may be done by any convenient means, provided the markings are still visible on the unburned portion of the specimen after the test is completed.

The apparatus for the test shall consist of a shield constructed from sheet metal or other fire-resistant material, 12-in (305 mm) in width, 12-in (305 mm) in depth, and 30-in (762 mm) in height, and open at the top. The shield shall be so constructed as to provide a ventilating opening approximately I-in (25 mm) in heightaround the bottom and shall have viewing window in one side, of sufficient size and in such a position that the entire length of the specimen under test may be observed. Because of danger due to breaking glass, it may be necessary to use heat-resistant glass for the viewing window. One side of the shield shall be hinged (or some other suitable form of construction used) so that the shield may be readily opened and closed to facilitate the mounting and ignition of the test specimen. A spring type of paper clamp shall be used for holding the test specimen in a vertical position with 12-in (305 mm) of the specimen exposed below the clamp. The holding clamp shall be attached rigidly to the shield in such a manner that when the specimen is clamped therein it iscentered within the shield facing the viewing window.

Ordinary laboratory grade benzene (C_6H_6) shall be used for ignition. A drop of benzene shall be placed on the test specimen approximately 1/4-in (6 mm) above the lower edge of the specimen, and allowed to run down to form a large drop on the blunt end without dripping off. Within 7 seconds after application to the test specimen, this drop shall be ignited by either of the following means: (1) a high-potential, low-energy spark such as that delivered by an automobile ignition coil; or (2) a safety match. After ignition, the door of the shield shall be closed immediately. The time required for the flame either to extinguish itself or to completely bum the test specimen shall be determined by means of a stop watch or timer, started at the instant of ignition. The area of the specimen that is burned or charred shall be measured to the nearest 1/4 in^2 (161 mm^2). The markings on the specimen may b-e used for estimating the amount of material burned. If material melts and drops from the specimen, the area melted shall be included in the burned area. The charred portion which drops off when touched with the fingers or in handling shall also be included in the burned area.

5.23.3 Interpretation of Results. The vertical bumingrate shall not exceed the following limits:

Thickness		Vertical Burning Rate	
in	mm	in^2/s	mm^2/s
0.005-0.010	0.13-0.25	1.0	645
0.01 l-0.015	0.28-0.38	0.50	323
0.016-0.050	0.41-1.27	0.25	161

If the specimen do-es not continue burning, it shall be reported as self-extinguishing.

5.24 Flammability, Test 24 (More Than 0.050-in [1.27 mm] in Thickness).

5.24.1 Purpose of Test. The purpose of this test is to determine the rate of burning of plastics or glass-plastic laminate glazings over 0.050-in (1.27 mm) in thickness.

5.24.2 Procedure. Three 6- x 0.5-in (152- x 13-mm), flat specimens, as submitted, shall be tested. The specimen shall be marked by scribing two lines l-in (25 mm) and 4-in (102 mm) from one end of the specimen.

The test shall be conducted in a room or enclosure protected from air currents, but provided with means for venting the fumes from burning specimens. A hood may be used if its exhaust fan is turned off during the test and allowed to run periodically to clear out the fumesbetween tests. Thespecimenshall beclamped in a support, at the end farthest from the 1 -in (25-mm) mark, with its inboard surface facing downward and with its longitudinal axis horizontal and its transverse axis inclined at 45” to the horizontal. Under the test specimen there shall be clamped a piece of 20-mesh per 25.4 mm Bunsen burner gauze about 5-in (127 mm) square, in a horizontal position 1/4-in (6 mm) below the edge of the spccimen, and with about l/Z-in (13 mm) of the specimen extending beyond the edge of the gauze.

A Bunsen burner or an alcohol lamp with a flame 1/2 to 3/4-in (13 to 19 mm) in height shall be placed under the free end of the test specimen and adjusted so that the flame tip is just in contact with the specimen. At the end of 30 seconds the flame shall be removed and the specimen allowed to burn. A stop watch shall be started when the flame reaches the first mark, l-in (25 mm) from the end, and the time observed when the flame reaches the 4-in (102-mm) mark. In case the plastic or glass-plastic laminate does not continue to burn after the first ignition, the burner shall be placed under the free end for a second period of 30 seconds immediately following extinction of the flame.

5.24.3 Interpretation of Results. The horizontal burning rate shall not exceed 3.5 in/m (1.48 mm/s). If the specimen does not continue burning to the 4-in (102-mm) mark after the second ignition, the specimen shall be reported as self-extinguishing. For glass plastic specimens only the plastic surface facing inward is subject to test and evaluation.

5.25 Egress, Test 25.

5.25.1 Purpose of Test. The purpose of this test is to determine whether or not the safety glazing material will provide an adequate means of egress from a motor vehicle without resort to "push-out" windows. This test need not be performed on glazing that is to be used in push-out windows or in windows not designed or intended for used as a means of egress.

5.25.2 Procedure. A vehicle body, a section of a vehicle body including the opening for which the test specimens are designed, or equivalent framing rigidly supported shall be mounted so it is firmly held where a 15-lb, 6-oz. (6.974-kg) shot bag (Fig, 7), forming the bob of a pendulum the length of which shall be not less than 10 ft (3.05 m) and that when freely swung will strike the test specimen at its approximate center. If the safety glazing material or multiple glazed unit is unsymmetrical in structure, the material shall be tested from both sides.

A specimen of 1/4-in (6.35-mm) nominal thickness laminated safety glass[25] of the identical size and shape as the specimen to be tested shall be glazed in the opening by the means designed for the safety glazing material or opening, or both, and shall be impacted normally to its major surfaces or to the tangent of its principal surfaces in the case of curved safety glazing materials. The impact test shall be conducted by raising the approximate center of gravity of the shot bag on the pendulum in increasing increments of 6-in (152-mm) beginning at 1 ft (303 mm) until the 1/4-in (6.35-mm) nominal thickness laminated safety glass[25] is driven out of the frame or so broken as to be readily removable by hand, The test shall then be repeated with four similar specimens of 1/4-in (6.35-mm) nominal thickness laminated safety glass.[25]

Five specimens of the safety glazing material under test shall then be glazed by the same means and tested successively in the same manner, care being exercised to establish that the frame is in an undamaged condition at the beginning of each test. The shot bag shall then be dropped from the greatest height arrived at in breaking the 1/4-in (6.35-mm) nominal thickness laminated safety glass.[25]

5.253 **Interpretation of** Results. Any safety glazing materials shall be deemed to have failed this test if the average drop of the shot bag for the series of five tests is higher than the average drop of quarter-inch (6.35 mm) nominal thickness laminated safety giass.

No provision of this test shall be so construed as to prohibit in a push-out window the use of a safety glazing material fulfilling the requirements of this test.

5.24 **Penetration Resistance,** Test 26[26]

5.26.1 Purpose of Test. The purpose of this test is to determine whether the glazing material has satisfactory penetration resistance.

5.26.2 Procedure. Ten 12- x 12-in (305- x 305-mm), substantially flat specimens, as submitted, shall be tested. Specimens to be tested shall be separated and kept at a temperature of 70°F to 85°F (21 °C to 29°C) for at least 4 hours immediately preceding the test to ensure a uniform temperature throughout each sample when tested. The specimen to be tested shall be supported in a maple or similar hardwood frame made in accordance with Fig. 1. The frame shall be so supported that the plane of the specimen will be substantially horizontal.

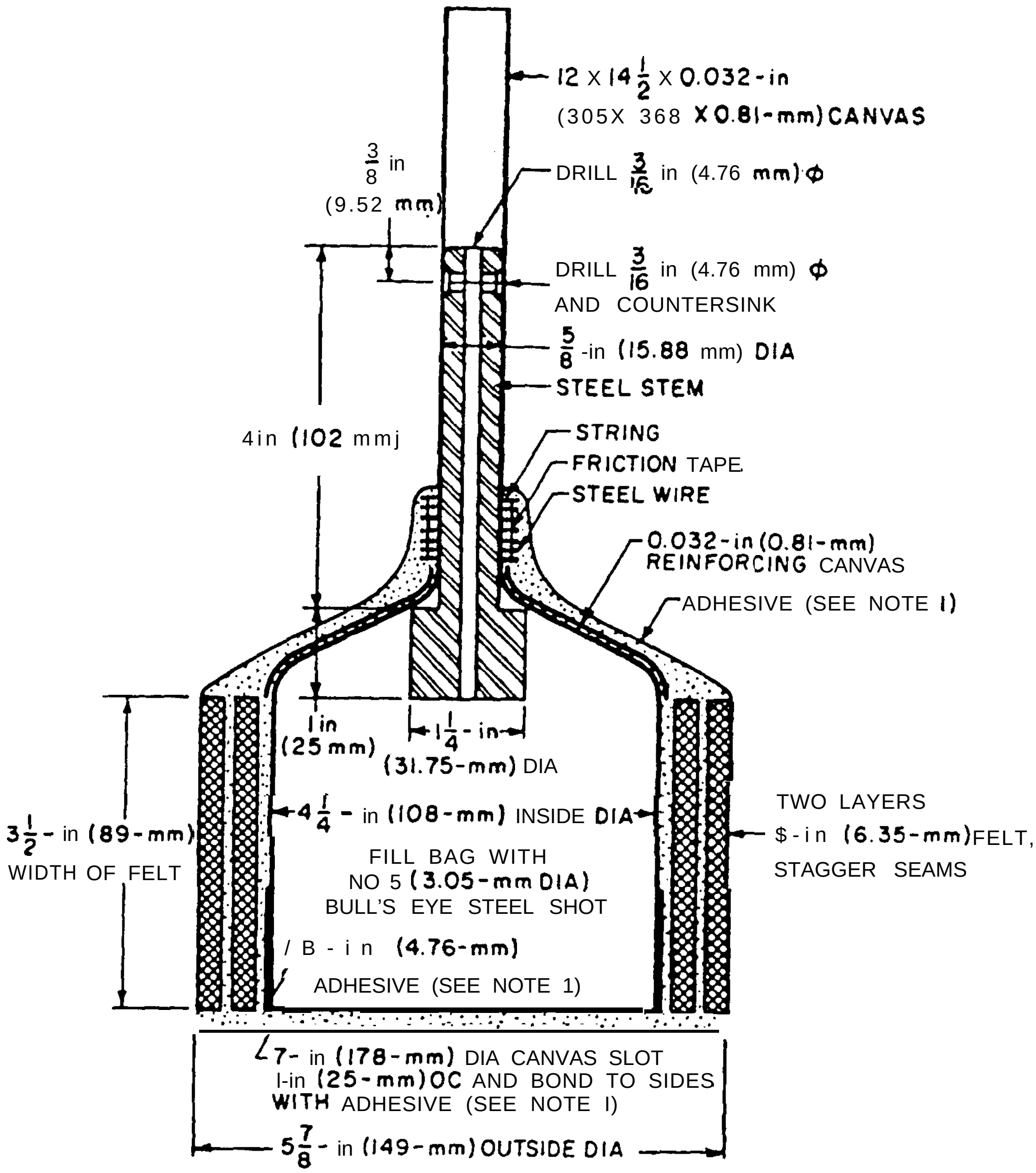
When necessary to retain the specimen in the frame, the specimen shall be clamped to ensure that the movement of the specimen during the test will not exceed 0.079-in (2-mm) at any point along the inside periphery of the frame.

A 5-lb ± 0.5-ounce (2.254- to 2.282-kg) solid, smooth steel sphere shall be dropped from a height of 12 ft (3.66-m), once, freely and from rest, so as to strike the approximate center of the surface that would be glazed to the interior of the vehicle. The ball shall be allowed to make only one impact with each test specimen.

5.26.3 **Interpretation** of Results. The impact may produce a large number of cracks in the glass and may cause tears in reinforcing interlayer material. The impact furthermore may

[25] The term "1/4-in (6.35-mm) nominal thickness laminated safety glass" means laminated safety glass meeting the requirements of this code and comprising two sheets of 1/8-in (3. 18-mm) nominal thickness, soft annealed glass laminated with a plasticized interlayer of polyvinyl butyryl of 0.030-in (0.76-mm) nominal thickness.

[26] According to SAE Recommended Practice J938a, June 1976.



NOTES:
(1) Such as 3M Company EC-801 or the equivalent.
(2) Weight: 15 lb. 6 oz (6.974 kg).
(3) Not to scale.

Figure 7
Pendulum Shot Bag

produce a substantial permanent deformation in the shape of the originally substantially flat specimen. However, with no more than two of the specimens shall the ball pass completely through the specimen within a 5-second interval after impact, either by what could be described as a puncture of the specimen or by means of the specimen fracturing into relatively large pieces that subsequently fold aside to permit passage of the ball. For glass plastic specimens only the plastic surface facing inward is subject to test and evaluation.

When the specimen is clamped, the specimens during the test exhibiting more than 0.079-in (2-mm) of movement at any point along the inside periphery of the frame shall be discarded and a new specimen substituted in its place.

5.27 Ballistics, Test 27

Bullet-resisting glazing of Type MP, Type HP, Type SP, and Type RR shall comply with the ballistics requirements specified by ANSI/UL 752-1980. Evidence of listing by Underwriters Laboratories, Inc., shall be considered proof of compliance.

5.28 Resistance to Temperature Change, Test 28

5.28.1 Purpose of Test. The purpose of this test is to determine whether or not the glazing material is capable of withstanding changes in temperature without deterioration.

5.28.2 Procedure. Two 12- x 12-in (305- x 305-mm) specimens shall be placed in air at a temperature of -40°F ± 9°F (-40°C ± 5°C) for a period of 6 hours, then placed in still air at 73°F ± 2°F (23°C ± 1°C) for 1 hour or until temperature equilibrium has been attained in the specimens. The specimens shall then be placed in circulating air at 162°F ± 4°F (72°C ± 2°C) for three hours. After removal to still air at 70°F to 81°F (21°C to 27°C) and cooling to this temperature, the specimens shall be examined.

5.28.3 Interpretation of Results. The glazing specimens shall show no evidence of cracking, clouding, delaminating, or other evidence of deterioration.

5.29 Impact, Test 29 (Ball Drop, 20 ft [6.10 m])

5.29.1 Purpose of Test. The purpose of this test is to determine whether the plies of bullet-resisting glazing are satisfactorily bonded together.

5.29.2 Procedure. The specimen shall be supported at its edges in a horizontal position employing a maple or similar hardwood frame made in accordance with Fig. 1. The temperature of the specimen shall be 0°F ± 10°F (-23°C to -12°C). The ball impact test shall consist of the dropping of a 5-lb (2.268-kg) steel ball from a height of 20 ft (6.10 m) onto the test specimen within 1-in (25 mm) of the center. If all glass plies are not broken on the fist ball impact, the specimen shaii be reversed and the same test repeated on the opposite glass surface. In the case of asymmetric laminates with only one exterior glass surface, the specimen shall be impacted once on each surface, starting on the giass side. In the case of laminates with no exterior glass surfaces, the specimen shall be impacted once on each surface. Any impact not occurring within I -in (25 mm) of the center of the assembly shall be disregarded and another assembly tested. Two specimens shall be tested.

5.293 **Interpretation** of Results. A specimen shall be considered to fail the ball impact test when delamination occurs between any adjacent plies along any crack or fracture line that extends more than 1/8-in (3 mm) normal to such crack or fracture line. Any delamination exceeding 1/4-in (6 mm) in its largest dimension shall also constitute failure. Delamination is a visible parting of separate layers as observable by reflected light. Giass spall in the area of impact on the impacted side or the spalling off of a cone-shaped mass in the area opposite the point of impact shall be disregarded.

5.30 Light **Stability,** Test **30**

530.1 **Purpose of Test.** The purpose of this test is to determine the regular (parallel) luminous transmittance of the bullet-resisting glazing before and after irradiation, thereby indicating its suitability and whether or not it is adversely affected by exposure to simulated sunlight or simulated weather conditions over an extended period of time.

5.30.2 Procedure. If safety glass is being tested, two 12- x 12-in (305- x 305-mm) specimens as submitted shall be tested by the procedure outlined in Test i through 5.1.2. If plastic glazing materials are being tested, two 2- x S-in (51- x 152-mm) specimens shall be tested by the procedure outlined in Test 16 through 5.16.2.

5.30.3 Interpretation of Results. The irradiated specimens shall retain at least 70% of the original transmittance as determined on the specimens as submitted. A very slight discoloration noticeable only when specimens are placed on a white background may develop, but defects other than this discoloration shall not develop.

5.31 Luminous Transmittance, Test 31

5.31.1 Purpose of Test. The purpose of this test is to determine the regular (parallel) luminous transmittance of the bullet-resisting glazing employed in motor vehicles.

5.31.2 Procedure. The data obtained in Test 30 through 5.30.2 on the regular (parallel) luminous transmittance at normal incidence calculated to International Commission on Illumination "Illuminant A" shall be used. No additional samples other than those tested in Test 28 or 30 are required in this test.

5.313 Interpretation of Results. Bullet-resisting glazings used in the motor vehicle shall show regular (parallel) luminous transmittance of not less than 60% of the light at normal incidence both before and after irradiation.

532 Optical Deviation and Visibility Distortion, Test 32

532.1 Purpose of Test. The purpose of this test is to measure the optical deviation and visibility distortion effects of flat or curved bullet-resisting glazings, or both. To this end, the procedure is divided into two parts: Optical Deviation (5.32.2.1) and Visibility Distortion (5.32.2.2).

5.32.2 Procedure. Six 12- x 12-in (305- x 305-mm), flat specimens of the bullet-resistant glass and, in the case of curved bullet-resisting glazing, three additional, approximately 12- x 12-in (305- x 305-mm), curved specimens (as described in Section 3, Specimens to Be Tested), curved to the minimum radius, shall be tested for optical deviation (see 5.32.2.1) and visibility distortion (see 5.32.2.2) before being subjected to other tests. That area of the specimen within l-in (25 mm) of any edge shall be covered with a suitable opaque mask.

5.32.2.1. Optical Deviation. Described in 5.15.2.1.

5.32.2.2. Visibility Distortion. Described in 5.15.2.2.

5.32.3. Interpretation of Results. Described in 5.15.3.

6. Edges

In vehicles except school buses, exposed edges shall be treated in accordance with SAE Recommended Practice J673 “Automotive Safety Glazing”, November 1983.

In school buses, exposed edges shall be banded.

7. Marking of Safety Glazing Materials.

In addition to any other markings required by law, ordinance, or regulation, all safety glazing materials manufactured for use in accordance with this code shall be legibly and permanently marked in letters and numerals at least 0.070-in (1.78-mm) in height= with the words "American National Standard" or the characters AS and, in addition, with a model number[27] that will identify the type of construction of the glazing material. They shall also be marked with the manufacturer's distinctive designation or trademark. In addition to the preceding markings and immediately adjacent to the words "American National Standard" or the characters AS, each piece of safety glazing material shall further be marked in numerals at least 0.070-in (1.78 mm) in height: if complying with the requirements of Section 4, Application of Tests, Item 1, with the numeral 1; if complying with the requirements of Section 4, Item 2, with the numeral 2; if complying with the requirements of Section 4, Item 3, with the numeral 3; if complying with the requirements of Section 4, Item 4, with the numeral 4; if complying with the requirements of Section 4, Item 5, with the numeral 5; if complying with the requirements of Section 4, Item 6, with the numeral 6; if complying with the requirements of Section 4, Item 7, with the numeral 7; if complying with the requirements of Section 4, Item 8, with the numeral 8; if complying with the requirements of Section 4, Item 9, with the numeral 9; if complying with the requirements of Section 4, Item 10, with the numeral 10; if complying with the requirements of Section 4, Item 11A, with the numeral and letter 11A; if complying with the requirements of Section 4, Item 11 B, with the numeral and letter 11B; if complying with the requirements of Section 4, Item 11C, with the numeral and letter 11C; ifcomplying with therequirementsofSection4, Item 12, with the numeral 12; if complying with the requirements of Section 4, Item 13, with the numeral 13; if complying with the requirements of Section 4, Item 14, with the numeral 14. The characters, or the words for which they stand, and the numerals as prescribed in this paragraph shall be outside of, and separate from the manufacturer's distinctive designation or trademark, but in close proximity thereto, preferably below.

If the manufacturer's code or date markings are used outside the trademark, they shall be separated from any other letters or characters by a space or hyphen to avoid confusion. Any section of safety glazing material Cut from a piece of safety glazing material marked by the manufacturer as indicated in this paragraph shall be marked with the same words, designation, characters, and numerals as the piece from which it was cut.

Bullet-resisting glazing shall be marked as required herein except that following the letters AS and the numeral, the type shall be designated. in letters at least0.070 in (1.78 mm) in height, as specified in 1.5.

Glazing materials, which in a single sheet of material are intentionally made with an area having a luminous transmittance of not less than 70% (Test 2), adjoining an area that has less than 70% luminous transmittance, shall be permanently marked at the edge of the sheet to show the limits of the area that is intended to comply with Test 2. The markings shall be A ↓ S 1 or A T S 2 and so forth, the direction of the arrow indicating the portion of the material that complies with Test 2 and the number indicating the item with which that portion of the sheet complies, This marking shall be in addition to the marking previously described, which shall also include the item number appropriate for that portion of sheet having a transmittance of not less than 70%.

Each manufacturer of glazing materials designed to meet the requirements of Item 11C, Item 12, Item 13 or Item 14 shall affix a label, removable by hand without tools, to each item of such glazing materials. The label shall identify the product involved, specify instructionsand agents for cleaning the material that will minimize the loss of transparency, and instructions for removing frost and ice and, at the option of the manufacturer, refer owners to the vehicle's Owner's Manual for more specific cleaning and other instructions. Further, each manufacturer of glazing materials designed to meet the requirements of Item 14 may permanently and indelibly mark the lower center of each item of such glazing material, in letters not less than 3/16-in nor more than 1/4-in high, the following words, "GLASS PLASTIC MATERIAL - SEE OWNER'S MANUAL FOR CARE INSTRUCTIONS".

[27] The model number shall be assigned by the manufacturer of the safety glazing material and shall be related by the manufacturer to a detailed description of a specific glazing material.

APPENDIX

(This Appendix is not part of ANSI/SAE Z26.1-1990, but is included for information only).

Table Al
Position of Glazing in Motor Vehicle

		Glazing Material Applicable when Marked with "AS" Designation Indicated Below	
		At Levels Requisite for Driving Visibility*	At Levels Not Requisite for Driving Visibility*, **
Passenger Cars	Windshields	1, 10, 14	1**, 10**, 14
	Interior partitions, auxiliary wind deflectors.	1, 2, 4, 10, 1 IA, 14	1, 2, 3, 4, 5, 10, 11A, 11B, 14
	Flexible curtains, readily removable windows, ventilators used in conjunction with readily removable windows, rear windows in tops of convertible cars.	1, 2, 4, 6, 10, 11A, 14	1.2. 3, 4, 5, 6.7, 10, 11A, 11B, 14
	Openings in roofs not required for driving visibility.	—	1, 2, 3, 4, 5, 10, 11A, 11B, 14
	All other glazing except as listed above.	1.2, 10, 1 IA, 14	1, 2, 3, 10, 11A, 14
Taxicabs	Windshields	1. 10, 14	1, 10**, 14
	Interior partitions, auxiliary wind deflectors, windows in rear doors.	1, 2, 4, 10, 11A, 14	1, 2, 3, 4, 5, 10, 1 IA, 11B, 14
	Openings in roofs not required for driving visibility.	—	1, 2, 3, 4, 5, 10, 11A, 11B, 14
	Flexible curtains, readily removable windows, ventilators used in conjunction with readily removable windows.	1, 2, 4, 6, 10, 11A, 14	1, 2, 3, 4, 5, 6, 7, 10, 11A, 11B, 14
	All other glazing except as listed above.	1.2. 10, 11A, 14	1, 2, 3, 10, 11A, 14
Trucks and Truck Tractors	Windshields	1, 10. 14	1**, 10**, 14
	Windows to immediate right and left of driver	1, 2, 10, 11A, 14	1, 2, 3, 10, 11A
	Rearmost window if used for driving visibility	1, 2, 8, 10, 1 IA, 14	1.2, 3, 4, 5, 8, 9, 10, 11A
	Glazing to rear of driver where other means to afford visibility of the highway is provided	1, 2, 3, 4, 5, 8, 9, 10, 11A, 11B	1, 2, 3, 4, 5, 6, 7, 10, 1 IA, 11B
	Folding doors	1, 2, 4, 8, 10. 11A, 14	1, 2, 3, 4, 5, 8.9, 10. 11A
	All other glazing except as listed above.	1, 2, 10, 11A, 14	1, 2, 3, 10, 11A

Table AI **(Cont)**
Position of **Glazing** in **Motor** Vehicle

		Glazing Material Applicable when Marked with "AS" Designation Indicated Below	
		At Levels Requisite for Driving Visibility*	At Levels Not Requisite for Driving Visibility*, **
Buses	Windshields	1, 10, 14	1**, 10**
	Glazing to immediate right and left of driver	1, 2, 10, 11A, 14	1, 2, 3, 10, 11A
	Rearmost window if used for driving visibility	1, 2, 8, 10, 11A, 14	1, 2, 3, 8, 9, 10, 11A
	Interior partitions and auxiliary wind deflectors	1, 2, 4, 10, 11A, 14	1, 2, 3, 4, 5, 10, 11A, 11B
	Folding Doors	1, 2, 4, 8, 10, 11A, 14	1, 2, 3, 4, 5, 8, 9, 10, 11A
	Standee Windows	—	1, 2, 3, 4, 5, 8, 9, 10, 11A, 11B
	Openings in roof not required for driving visibility	—	1, 2, 3, 4, 5, 10, 11A, 11B
	Flexible curtains, readily removable windows, ventilators used in conjunction with readily removable windows.	1, 2, 4, 6, 10, 11A, 14	1, 2, 3, 4, 5, 6, 7, 10, 11A, 11B
	All other glazing except as listed above.	1, 2, 3, 10, 11A, 14	1, 2, 3, 10, 11A
Trailers	All Glazing	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11A, 11B	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11A, 11B
Motorcycles	Windscreens	1**, 6, 10**, 11A, 14	1, 6, 7, 10

* The numbers shown are item numbers as described in Section 4, Application of Tests, and as used in Table 1.

** Glazing material that is intentionally made so that only a portion of a single sheet has a luminous transmittance of not less than 70% shall be marked at the edge of the sheet to show the limits of the area that may be used at levels requisite for driving visibility. The marks A ↓ S 1 or A ↑ S 2, and so forth, shall be used, with the arrow pointing to the portion of the sheet having a luminous transmittance of not less than 70%, and the number indicating the item with which that portion of the sheet complies.

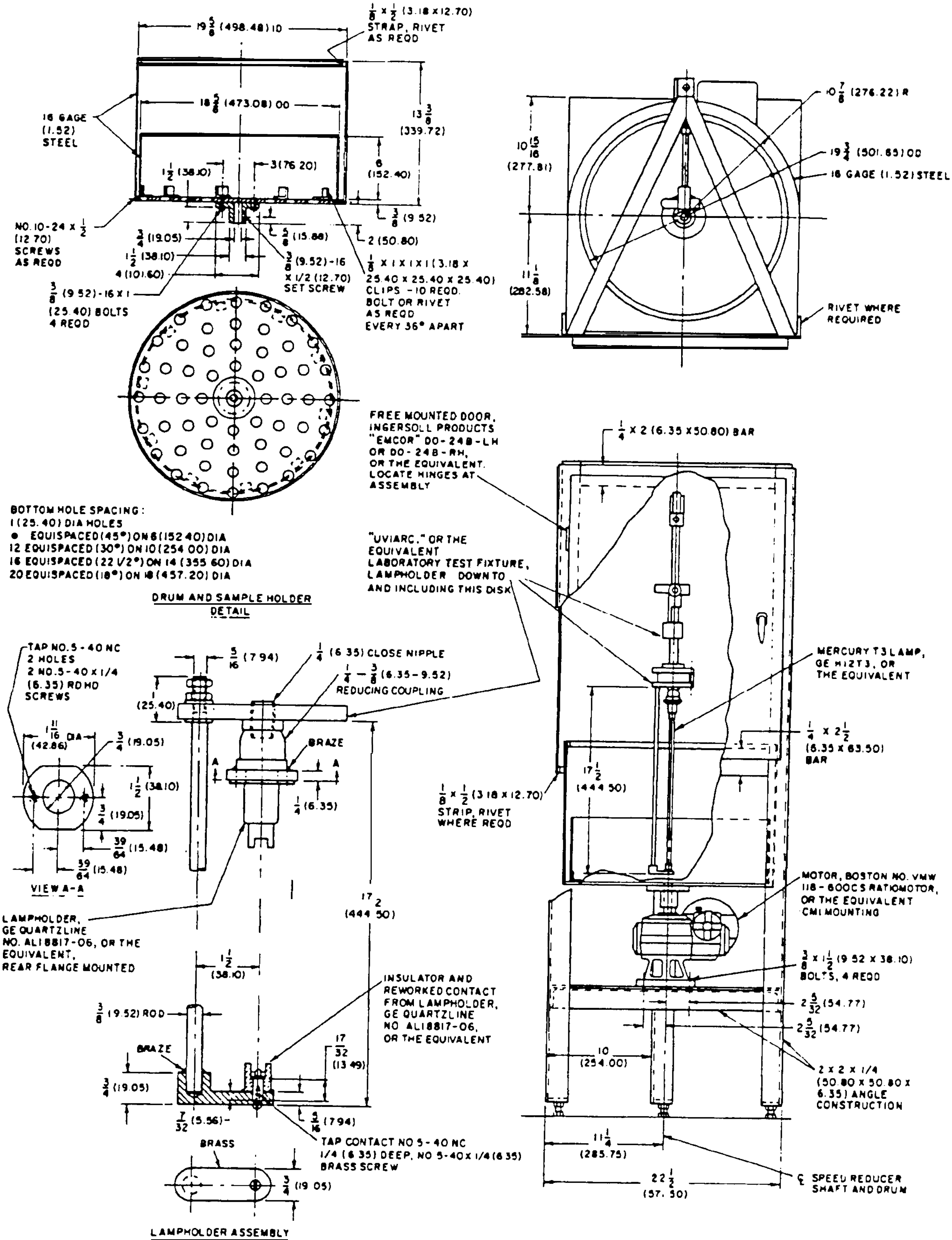
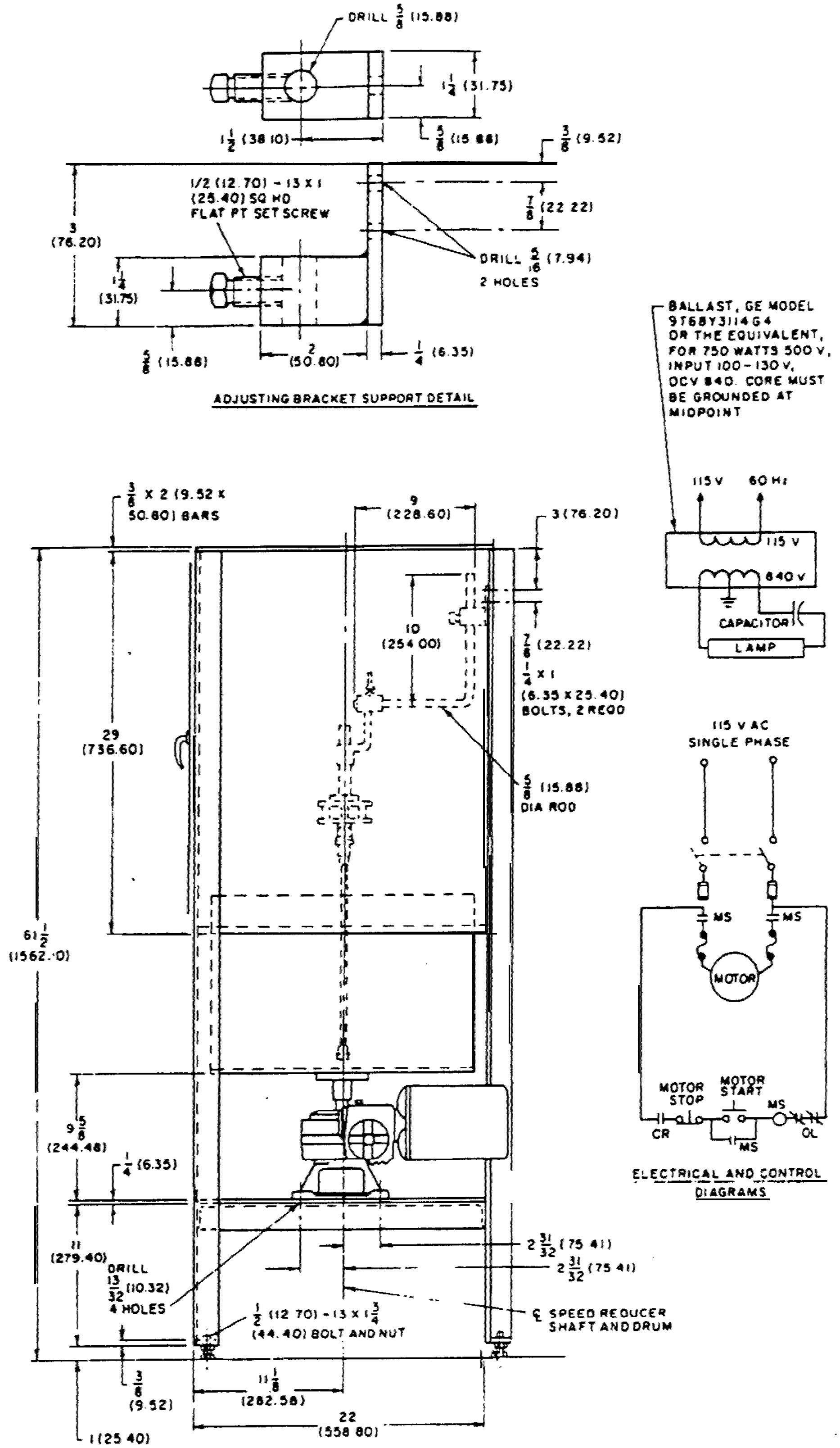


Figure Al
Light Stability Test Equipment



NOTE: All dimensions are in customary units (inches), with metric dimensions (millimeters) in parentheses.

SCALE: 3 inches = 1 foot (1 mm = 4 mm)

Figure A1 (Cont)
Light Stability Test Equipment

EDITORIAL CORRECTIONS TO THE FIRST PRINTING OF ANSI/SAE Z26.1-1990

Front Cover:

Add reference to “Editorial Correction August 1991.”

Title Page:

Add reference to “Editorial Correction August 1991.” and “Second Printing February 1992.”

Copyright Page:

Add “Second Printing February 1992.”

Table of Contents:

Change the page number for Section 3.4 from 5 to 6.

Page 5:

Add item (3) under clause 3.2.1:

(3) In addition, for Fracture, Test 7, six production parts representing each model construction are to be furnished for the test.

Page 9:

Under Item 2, part (d), add Test 6 to the second series of tests. It should read:

. . . . or Tests 1, 2[5], 3, 5, 6, 7, 8, 14, and 18.

Under Item 3, part (1), change the second “in” to “if’ to read:

. ..in the rearmost window if the latter is used for driving visibility.

Page 25:

In Section 5.15.2.2, last paragraph, change the metric equivalent of 5-in to (127 mm).

In Section 5.15.3, change the reference 5.15.3.1 to 5.15.2.1.

In the NOTE of Section 5.15.3, change the metric equivalent of 25 ft to (7.62 m).

Page 31:

Foomote 24 should appear on this page as well as Page 32.

Page 33:

In the table in Section 5.23.3, change the Vertical Burning Rate for 0.011-0.015 in thickness to 0.50 in²/s.

Page 34:

In Section 5.25.2, before the last paragraph, insert a new Section 5.25.3:

5.25.3 Interpretation of Results. Any safety glazing materials shall be deemed to have failed this test if the average drop of the shot bag for the series of five tests is higher than the average drop of quarter-inch (5.35 mm) nominal thickness laminated safety glass.

No provision of this test...

Section 5.26 should read:

5.26 Penetration Resistance, Test **26**[26]

Page 37:

In Section 5.32.2, change the reference (see 5.32.2.20) to (see 5.32.2.2).

Change Section 5.32.2.3 to Section 5.32.3. The title "Interpretation of Results" should be in bold type.

Page 41:

Under Taxicabs:

For flexible curtains, add Tests 6 and 7 under Levels Not Requisite for Driving Visibility.

Change "Trucks and Truck Trailers" to "Trucks and Truck Tractors."

Under Trucks and Truck Tractors:

For windshields, change listing of tests under Levels Not Requisite for Driving Visibility to read I**, IO**, 14.

For windows to immediate right and left of driver, remove Tests 4, 5, 8, 9 under Levels Not Requisite for Driving Visibility.

For rearmost window, remove Test 11B under Levels Not Requisite for Driving Visibility.

For glazing to rear of driver, add Test 11B under Levels Not Requisite for Driving Visibility.

For folding doors, add Tests 4, 5, 8, 9 under Levels Not Requisite for Driving Visibility.

For all other glazing, remove the extraneous line (1, 10**, 14) under Levels Requisite for Driving Visibility.

For all other glazing, add Tests 1, 2, 3, 10, I IA under Levels Not Requisite for Driving Visibility.

Exhibit I

UIC Standard 627

INTERNATIONAL UNION OF RAILWAYS

U I C CODE

Leaflet to be classified in Volume :

VI - TRACTION

627-2

O

2nd edition, 1-7-80

FILLING DEVICES

FOR DIESEL STOCK

(Reprint of 1-7-1987)

REVISIONS

Leaflet **627-2, 2nd** edition, I-7-60			
Amendment		Amendment	
No.	Dote	**No.**	**Date**

NOTE

This leaflet is part of a set which also includes :

Leaflet 563 : Fittings provided in coaches in the interests of hygiene and cleanliness.

CONTENTS

0 -SCOPE OF APPLICATION

The regulations set out below shall apply to the filling devices of Diesel stock to be built in the future and intended to be used on international services.

1 - FILLING DEVICES FOR MOTOR FUEL AND FOR BOILER FUEL

Each tractive unit must be fitted with filling devices for motor fuel and for boiler fuel, making it possible to carry out the fuelling operation from above, without pressure, from a supply installation.

Filling devices (filling couplings), as well as fuel tanks, including their connection pipes and ventilation apertures, must be of a size and so arranged that it is possible to obtain a fuel flow of :

- 200 I per minute as regards tanks with a capacity of less 500 I ;

- 400 I per minute as regards tanks with a capacity exceeding 500 l.

1.1 - Type of filling coupling

Simple filling coupling with a minimum aperture diameter of 70 mm.

1.2 - Number and position of filling couplings

For each independent installation : a filling coupling on each side of the vehicle . Centre of the coupling aperture : maximum 1500mm above rail level.

1.3 - Sealing cover

Filling couplings must be fitted with sealing covers secured to the coupling to prevent loss.

2 - FILLING DEVICES
FOR THE FUEL OF INDEPENDENT PRE-HEATING
OR KEEPING-WARM DEVICES

Tractive units with pre-heating or keeping warm devices which are not supplied from tanks as per Point 1, must be fitted with filling devices for the fuel intended for these independent installations.

2.1 - Type of filling coupling

Simple filling coupling with a minimum aperture diameter of 70 mm.

2.2 - Number and position of filling couplings

For each independent installation : a filling coupling on each side of the vehicle.

2.3 - Sealing cover

The filling coupling must be fitted with a sealing cover secured to the coupling to prevent loss.

3 - FILLING DEVICES FOR ENGINE-COOLING WATER

Each tractive unit, with watercooled motors, must be fitted with :

- a filling device as specified in 3.1 and

- a filling device as specified in 3.2 or 3.3.

3.1 - Device making it possible to carry out the filling operation from below, from fixed installations supplying water under pressure by means of flexible water-tight hoses

3.1 .1 - Type of filling coupling

Connection for hose coupling, complying with Appendix 1 (right-hand figure) of UIC Code Leaflet 563. A free choice of the other details is permitted.

3.1.2 - Number and position of filling couplings

For each independent water-circuit : a filling coupling on each side of the vehicle. The centre of the coupling aperture must be situated at a maximum height of 1250 mm above rail level.

3.2 - Device making it possible to carry out the filling operation from below by suction in a bucket or any other receptacle, by means of a pump fitted in the vehicle and a water-tight flexible hose

3.2.1 - Type of filling coupling :

The hose coupling as shown in Appendix 1 (figure on right) to UIC Code leaflet 563. A free choice of the other details is permitted.

3.2.2 - Number and position of filling couplings :

For each independent water circuit : a filling coupling on each side of the vehicle.

The centre of the coupling aperture must be situated at a maximum height of 1250 mm above rail level.

3.2.3 - Bucket and hose form part of the vehicle equipment.

3.3 - Device making it possible to carry out the filling operation from above, without pressure, by means of a bucket or any similar receptacle and a funnel.

3.3.1 - Type of filling coupling

Simple filling coupling with a minimum aperture of 50 mm diameter.

3.3.2 - Bucket and funnel form part of the vehicle equipment.

4 - FILLING DEVICES FOR THE WATER SUPPLY OF THE BOILER

Each vehicle equipped with a boiler must be fitted with a filling device making it possible to carry out the filling operation from below, from fixed installations supplying water under pressure, by means of water-tight flexible hoses.

The filling device (filling coupling), as well as the water supply tanks and their communicating piping and ventilation apertures must be of a size and so arranged that a flow of 1,000 litres per minute can be obtained. For this flow, the pressure measured at the filling coupling must not exceed 1 bar.

4.1 - **Type of** filling **coupling**

Filling couplings must be fitted with a fixed coupling, as per Appendix 1 to this leaflet.

4.2 - Number and position of filling couplings :

For each independent installation : a fixed coupling on each side of the vehicle.

The centre of the coupling aperture must be situated at a maximum height of 1250 mm above rail level.

4.3 - If required, the aperture of the filling coupling may be sealed by a dummy coupling, in accordance with Appendix 2 to this leaflet.

4.4 - Appendix 3 to this leaflet specifies the removable coupling of the flexible hose necessary for the filling operation carried out from the fixed installation supplying water under pressure.

5 - FILLING DEVICES FOR THE WATER SUPPLY OF SANITARY INSTALLATIONS, ETC...

Each vehicle equipped with sanitary installations, etc... using water must be fitted with devices making it possible for the filling operation to be carried out from below, from fixed installations supplying water under pressure by means of water-tight flexible hoses.

5.1 - Type of filling coupling

Connection for hose coupling, in accordance with Appendix 1 (right-hand figure) of UIC Code leaflet 563 ; a free choice of the other details is permitted.

5.2 - Number and position of filling couplings

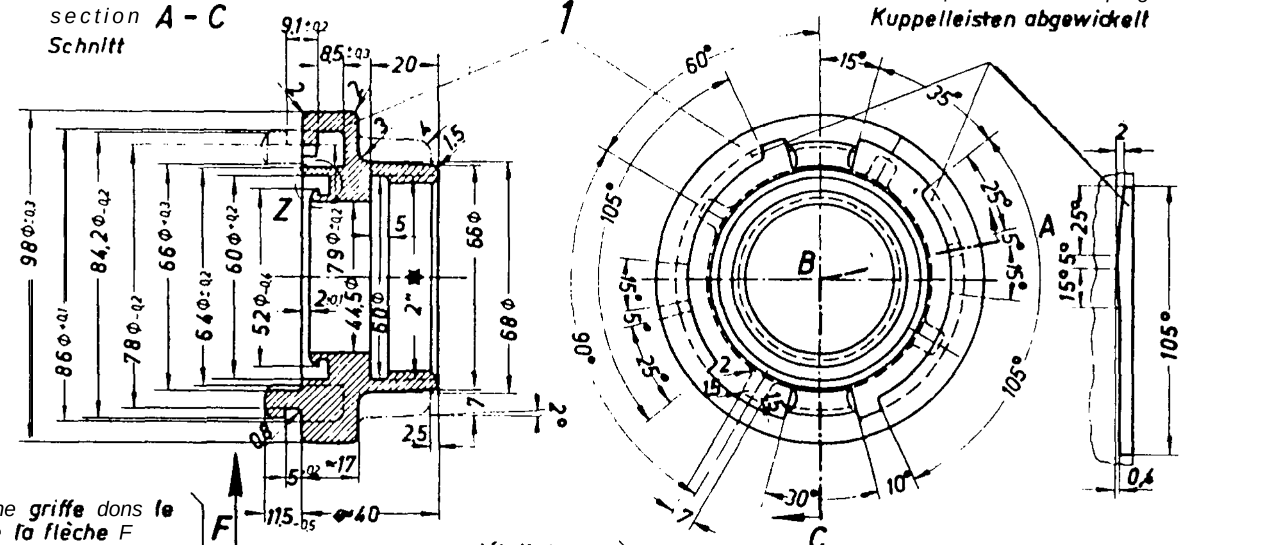
For each independent installation : a filling coupling on each side of the vehicle.

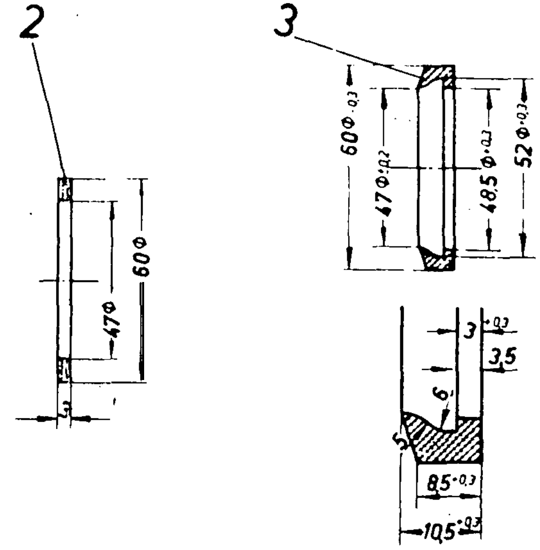
The centre of the coupling aperture must be situated at a maximum height of 1250 mm above rail level.

DISPOSITIF DE REMPLISSAGE POUR L'EAU D'ALIMENTATION DE LA CHAUDIERE (REMPLISSAGE SOUS PRESSION)
FILLING DEVICE FOR STEAM BOILER FEED WATER (FILLING UNDER PRESSURE)
NACHFÜLL-EINRICHTUNG FÜR SPEISEWASSER ZUM DAMPFKESSEL DER HEIZUNGSANLAGE (NACHFÜLLUNG UNTER DRUCK)

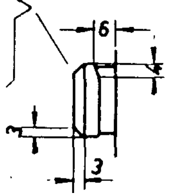
coupe
section A - C
Schnitt

2 rompes d'accouplement développeés
Development of 2 coupling surfaces
Kuppelleisten abgewickelt

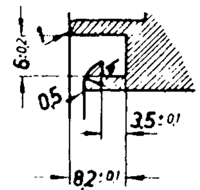




vue d'une griffe dons le sens de la flèche F
View of a key in the direction of arrow F
Ansich t einer Knogge in Pf ei lrich t ung F



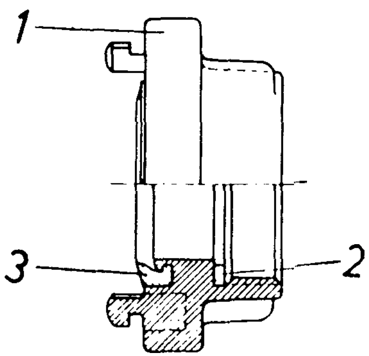
détail de
Detail at
Einzelheit bei
Z



lo partie lo plus épaisse se trouve dons le plon A-8
The thickest part of the coupling surface is situated on the plane A - B
Die dickste Stelle der Kuppelleiste liegt in der Ebene A-B

repère	disignolion	matière
part n°	description	material
Teil-Nr.	Bezeichnung	Werkstoff
1	roccord à griffes key piece Knoggenteil	
2	rondelle d'étanchéité plate flat packing ring Flachdichtring	en cuir/en caoutchouc leather/rubber Leder / Gummi
3	joint d'étanchéité packing ring Dichtring	en caoutchouc rubber Gummi

✱ filetage Whitworth avec filets tronqués pour tube de 2"
2" Whitworth pipe thread
2" Rohrgewinde



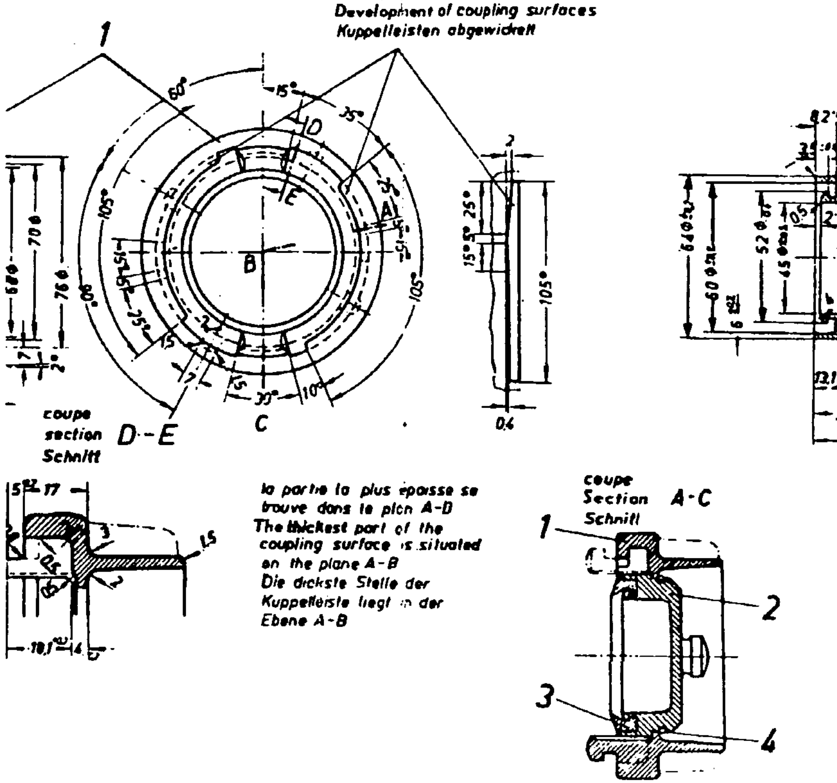
Accouplement fixe
Fixed coupling
Festkupplung

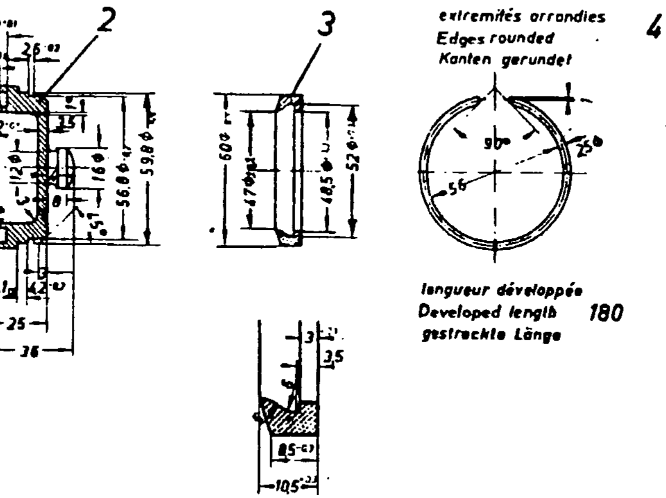
Pour les cotes dont les tolérances ne sont pos menlionnies por ie dessin la tolérance à respecter est de ± 0,5
For the dimensions. for which tolerances ore not mentioned in the drawing, the tolerance lo be observed is ± 0.5
Für dre Maße, deren Toleranzen in der Zeichnung nicht aufgeführt beträgt die einzuhaltende Toleranz ± 0,5

627-2

ANNEXE 2
APPENDIX 2
ANLAGE 2

DISPOSITIF DE REMPLISSAGE POUR L'EAU D'ALIMENTATION DE LA CHAUDIERE (REMPLISSAGE SOUS PRESSION
FILLING DEVICE FOR STEAM BOILER FEED WATER (FILLING UNDER PRESSURE)
FÜLL-EINRICHTUNG FÜR SPEISEWASSER ZUM DAMPFKESSEL DER HEIZUNGSANLAGE (NACHFÜLLUNG UNTER D



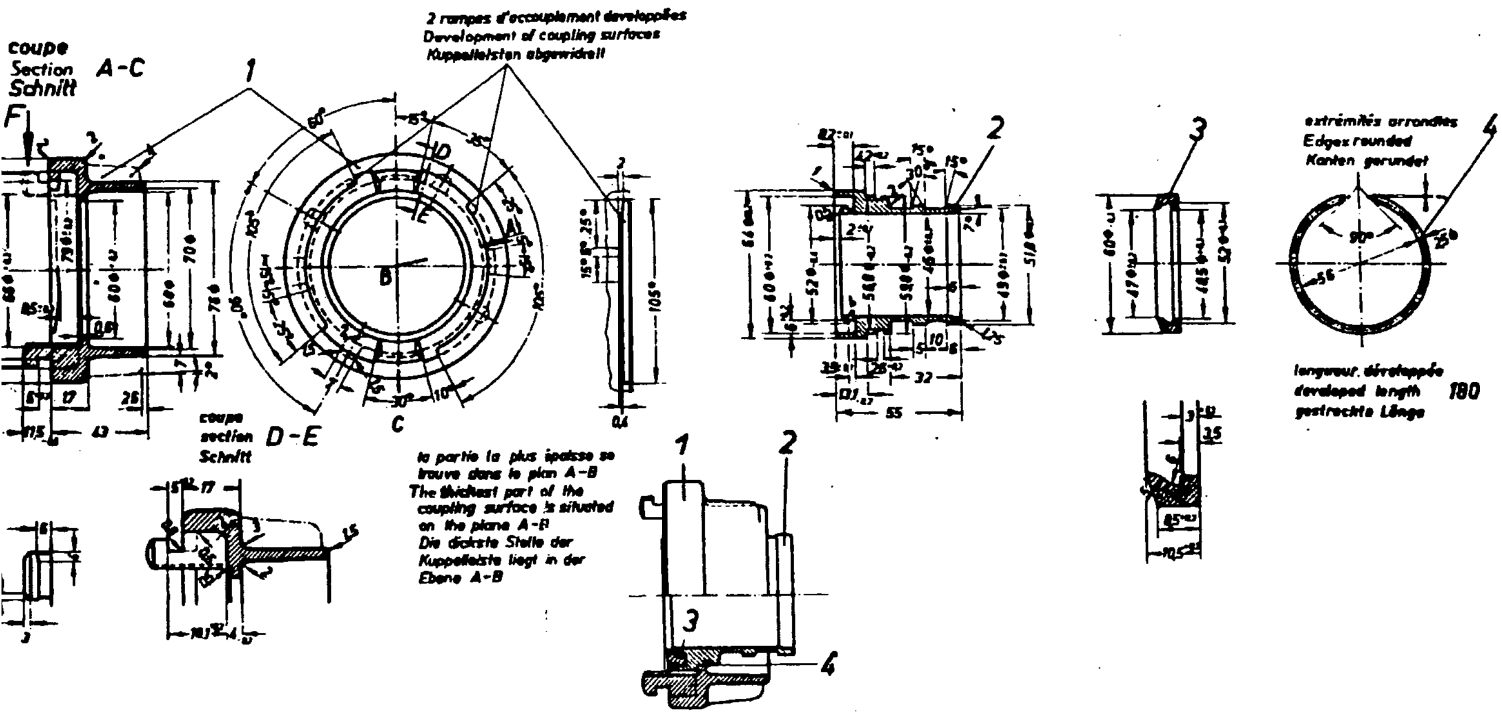


Pour les cotes dont les tolérances ne sont pas mentionnées par le dessin la tolérance à respecter est de ± 0,5
For the dimensions, for which tolerances are not mentioned in the drawing, the tolerance to be observed is ± 0,5
Für die Maße, deren Toleranzen in der Zeichnung nicht aufgeführt, beträgt die einzuhaltende Toleranz ± 0,5

repère	désignation	matière
part nº	description	material
Teil-Nr.	Bezeichnung	Werkstoff
1	raccord à griffes key piece Knaggenteil	
2	couvercle cover Deckel	
3	joint d'étanchéité packing ring Dichtring	caoutchouc rubber Gummi
4	anneau de blocage retaining ring Sperring	

Faux accouplement
Dummy coupling
Blindkupplung

DISPOSITIF DE REMPLISSAGE POUR L'EAU D'ALIMENTATION DE LA CHAUDIERE (REMPLISSAGE SOUS PRESSION)
FILLING DEVICE FOR STEAM BOILER FEED WATER (FILLING UNDER PRESSURE)
NACHFÜLL-EINRICHTUNG FÜR SPEISEWASSER ZUM DAMPFKESSEL DER HEIZUNGSANLAGE (NACHFÜLLUNG UNTER DRUCK)



Pour les cotes dont les tolérances ne sont pas mentionnées par le dessin la tolérance à respecter est de ±0,5
For the dimensions, for which tolerances are not mentioned in the drawing, the tolerance to be observed is ± 0,5
Für die Maße, deren Toleranzen in der Zeichnung nicht aufgeführt beträgt die einzuhaltende Toleranz ± 0,5

repère	désignation	matière
part nº	description	material
Teil-Nr.	Bezeichnung	Werkstoff
1	raccord à griffes key piece Knaggenteil	
2	tubulure à emmancher Hose half-coupling Einbindestutzen	
3	joint d'étanchéité packing ring Dichtring	caoutchouc rubber Gummi
4	anneau de blocage retaining ring Sperring	

Accouplement mobile
Removable coupling
Bewegliche Kupplung